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# AGRICULTURAL ENGINEERING

APRIL · 1945

U.S.D.A. Water Policy in Relation to Western Agriculture *Hon. Claude R. Wickard*

Agriculture's Challenge to Agricultural Engineers *C. L. Hamilton*

Results of Studies of Flame Cultivation of Row Crops *P. W. Gull*

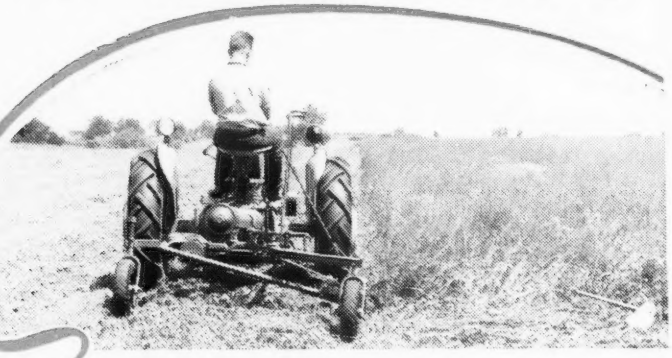
Engineer Reviews Postwar Farm Structures Situation *K. J. T. Ekblaw*

The Development of a Mechanical Filbert Nut Picker *F. E. Price. R. N. Lunde*

THE JOURNAL OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

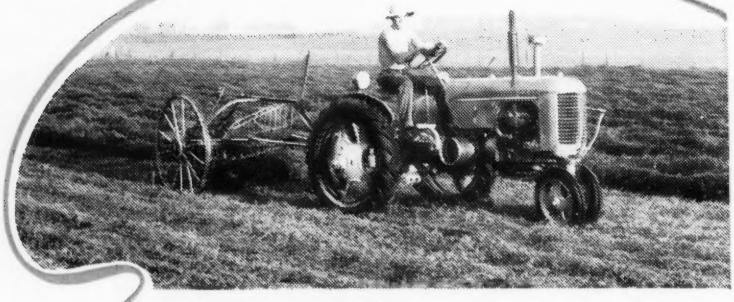
# 3 Simple Steps

## For Making Better Hay



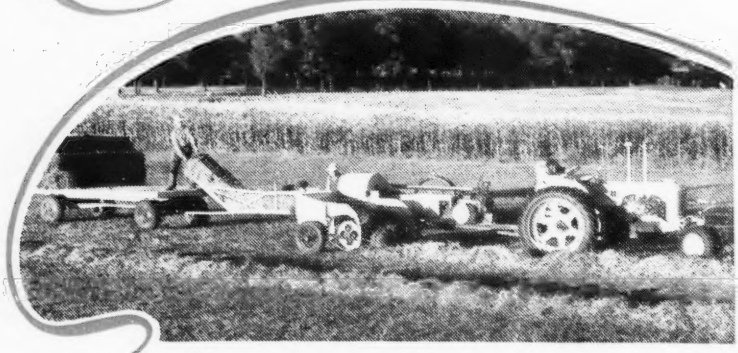
1

**Cut When Protein is High,** usually earlier than has been customary. Mow only what you can take up in one day. Cut quickly, to secure uniform curing. The new Case trailer-mower takes 7-foot swath, best width for ideal windrows; cuts three acres an hour. It has power take-off drive for fast, full-swath cutting regardless of footing, yet hitches quickly to any modern tractor.



2

**Windrow When Wilted,** before any leaves are dry enough to bleach or shatter. Rake in same direction as mowing to put leaves inside, protected by stems outside. Case side-delivery rakes have scientifically curved teeth to make high, fluffy windrows that favor quick curing. Tractor model has 4-bar reel geared slower for clean, gentle raking at modern tractor speeds.



3

**Put up "Packaged Pasture"** with a Case Sliced-Hay pick-up baler. It handles 7-foot swath at same fast speed as tractor mower and rake, permits baling at uniformly correct cure. Gentle pick-up and complete absence of feeder-head avoid rough handling that might thresh off precious leaves. Bales open up into portions like sliced bread; no pulling apart to lose leaves at feeding time.

Conservation farming, livestock and dairy production and farm labor load all come to a bottleneck in HAY. This message, one of a series appearing in the farm papers, is aimed to inspire haying practices that enlarge the place of grass crops in rations and in rotations. You are invited to make use of the educational booklet "How to Produce High-Protein Hay." J. I. Case Co., Racine, Wis.

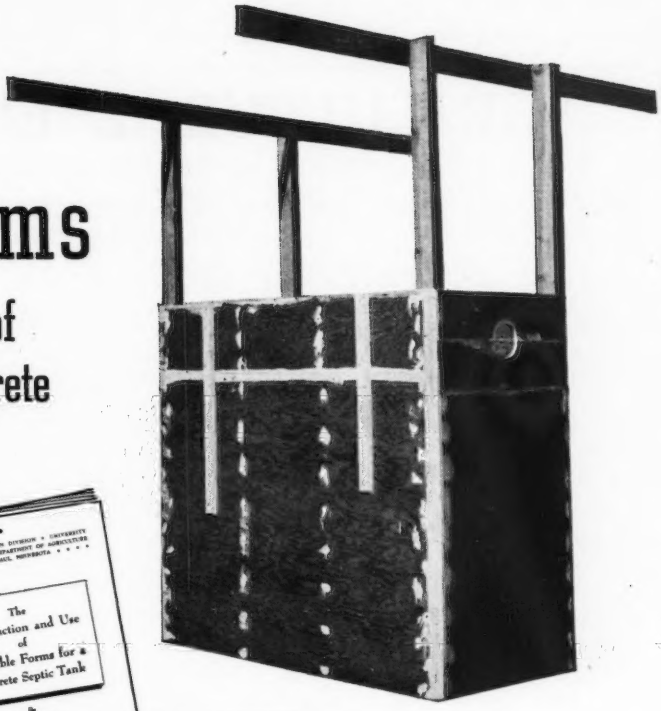
★

★ ★

CASE

# Plywood Concrete Forms

## The Construction and Use of Re-usable Forms for a Concrete Septic Tank



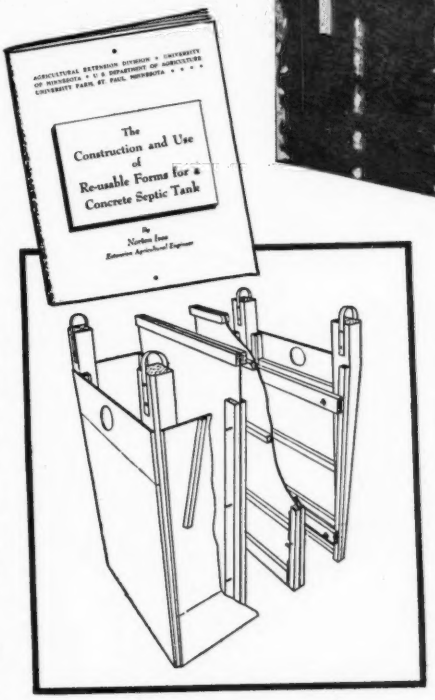
PLYFORM is the name for the special grade of oiled Douglas fir plywood intended for concrete forms. It is made with a highly moisture-resistant, but not insoluble, adhesive and is intended for multiple reuse.

Handling with reasonable care, cleaning, re-oiling or painting and protecting from moisture between uses will add to the life. Many contractors find the panels serve ten or more uses. Fastening the panels into frames will help protect the edges against rough handling. Damaged edges of loose panels used against rough framing can often be trimmed to give smaller, but still usable panels.

Concrete poured against PLYFORM forms has a smooth, dense surface almost free of "fins". Contractors find such forms easier to handle, and more economical when reuse possibilities are considered.

Rural contractors find PLYFORM forms desirable for concrete foundation and basement walls, dairy barn walls, grain bins, silos, water tanks, feed troughs and mangers, and similar structures.

An interesting use of plywood forms is in community septic tank forms. The University of Minnesota




publication, which has been reprinted as illustrated, gives an interesting description of re-usable forms for this purpose and suggestions for their construction and use.

It states — "The forms are designed for hard use, and ease and simplicity of handling, which may explain the elaborate construction. Considering that they may be used 25 or more times, good construction is warranted. The experimental set has been used for seven tanks, and so far has shown very little wear.

"Five ply, one-half inch plywood is used for the walls. The new type of exterior waterproof plywood may be used, but it is considerably more expensive, and it has been found that ordinary concrete form plywood will serve well if it is given two or three coats of waterproofing paint and periodically repainted."

PLYFORM
TRADE MARK REG. U.S. PAT. OFF.

This grade of Douglas fir plywood is made with highly water-resistant glues especially for multiple-use concrete forms. Surfaces are sanded to a satiny smoothness and are mill-oiled. Every panel is stamped with a diamond-shaped grade-mark, clearly identifying it as PLYFORM, DFPA Inspected.

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**Tacoma 2, Washington**

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**Farm Buildings Are War Equipment . . . Keep Them Fit and Fighting!**

# AGRICULTURAL ENGINEERING

*Established 1920*

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This Journal is owned, edited, and published monthly by the American Society of Agricultural Engineers.

Editorial and advertising departments at the executive office of the Society, Saint Joseph, Michigan. Publication office at Benton Harbor, Michigan.

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420 Lexington Ave.
Tele: LEXington 2-4816

SUBSCRIPTION PRICE: $3.00 a year, plus an extra postage charge to all countries to which the second-class postage rate does not apply; to A.S.A.E. members anywhere, $2.00 a year. Single copies (current), 30 cents each.

POST OFFICE ENTRY: Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921.

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# EDITORIAL

## Wickard on Water

SPEAKING somewhat from a lay viewpoint, since we could not possibly be well informed in such immensity and diversity of subject matter, we make bold to commend the paper presented by Secretary of Agriculture Claude R. Wickard before the Washington (D.C.) Section of the American Society of Agricultural Engineers and published as the leading article in these pages. First should be praise for the clarity with which policies have been defined and complex activity described in so short a space.

Only when the whole subject of water policy is so comprehensively compressed can we sense the infinity of interlocking interests and technologies which are involved. We must be humble because engineering is only a fractional phase of the over-all picture, yet can be proud that our profession's fraction is vital. Perhaps we might even boast that among the blunders of the past comparatively few are of strictly engineering nature. Whether we have looked up from our slide rules and contributed our full share of vision toward broad policy is not so sure.

The Secretary's paper impresses us with the increasing need for correlation, not only in the common and sometimes conflicting interests of states, regions, and nations, but in the various aspects of agriculture itself. Without derogation to the worthy work, past and in process, by the several states and by the pioneer courage of private enterprise, it seems obvious that there is indispensable place for the far-flung, far-sighted authority of the U. S. Department of Agriculture.

Mr. Wickard displays keen appreciation of the interdependence of agriculture and other industries. Skipping many intermediate steps, this means that the expansion of water facilities, or of any expedients for greater agricultural production, should be synchronized with expanding ability of consumers and of industry to absorb farm products. Since such advancement is not steady but consists of recurring cycles, there is need to make capital improvements, i.e., the installation of reclamatory works, when they are *not* needed. By such timing in the cycle, the employment of labor and the purchase of supplies mitigate the severity of depression and at the same time prepare agriculture for its place in the prosperous period to follow.

The Secretary's appearance before the A.S.A.E. Washington Section meeting implies his regard for the influence of the agricultural engineering profession in furthering and possibly in guiding public policy as it falls within his domain. We should accept not only the compliment, but the challenge to exercise our influence as citizens with special vision arising from our training and experience.

## Obsolescent Farmers

THE paper by K. J. T. Ekblaw, appearing in this issue, fortifies further the facts regarding the deplorable depreciation in America's farm structures, dating back some three decades. With each year passed and each survey made the decadence of the farm structures plant becomes greater and more thoroughly known. But since the building decline has continued through war, postwar boom, prolonged depression and back into war, it seems obvious that we must look for its cause to something more than the routine economics of the business cycle.

No doubt there are many causes. Probably contributory is a condition mentioned in a county-wide meeting of Wisconsin farmers, as brought to mind by the holding of the farm census recently. In a certain area, perhaps not the entire county, the youngest farmer was aged 46, and the others ranged from 52 to 76. Qualitatively this is true of all American agriculture, that the farmer is older than ever before in our history. Much if not most of him already is past the customary retirement age.

It would seem natural that farmers due, or past due, for retirement should shrink from a program of building renewal or rehabilitation. It also would seem inevitable that these overage farmers must soon be succeeded by others. Will these successors be building-minded? Will they have the cash or credit, as well as the desire to build? If they are going to build, what manner of structures will they want, or can they be educated to want?

Study of these and allied questions might well be undertaken by farm structures engineers, and by industries concerned with farm building. It may be time to stop looking at the barns of yesterday and take a look at the farmer of tomorrow.

## Power for Peace

ON THE floor of the Congress some weeks ago, if we remember aright, was uttered a solemn avowal of faith that true peace cannot come into the world by covenants among nations, nor by weight of military power, but only by actual practice of Christianity among the peoples of the earth. To this might be added that only thus is there hope of goodwill among the people of our own nation.

None is more sensitive than the engineer himself to the fact that the fruits of his toil may be turned to the horrors of war as well as to the blessings of peace. No one regrets it more. Recognizing quite frankly that the technical temperament seldom lends itself easily to the militant manifestations of religious fervor, we still believe that the agricultural engineer, at least, firmly favors the influence of religion as a social force, as a personal guide, and as a power for peace.

Even though we feel unfit to assume the role of saintly leadership, we still can give material and moral support to every agency and avenue of spiritual strength. We can exalt the example set by others more successful in overcoming the frailties of the flesh and in achieving the things of the spirit. We can credit to Christian teaching through the ages most of the ethics and morals which make tolerable the relations among men and among nations.

In particular, we can concentrate our influence, notably our parental authority, on the religious teaching of children. Seldom does preadolescent training fail to maintain its measure of faith and direction throughout life, however much the adult may neglect the formalities of religion, or come into intellectual conflict with its doctrines. It is the least we can do, yet perhaps the most we can do, toward making man fit to live with himself and with his fellows.

## Earning vs. Book Value

AT THE Wisconsin meeting cited above, it was argued that a farm is not over-priced as long as it sells for less than the value of buildings and fences. No matter whether depreciated or replacement value was meant, it emphasizes the need for evaluation of farm structures in terms of earning capacity. Engineers, economists and farm management men may well cooperate on this question.

# Come, shake the Walnut Tree!

Out of the manpower shortage and soaring demands for food production have come some unusual "home-talent" machines —to save time and labor.

The machine shown mounted on this Diesel D2 Tractor is a home-made walnut shaker—contrived on Cole Brothers Ranch, Whittier, California.

With it, the Coles report, one man can shake 10 acres of 50-year-old walnut trees in one day. By the former method of using tractor and tower, it took 3 men, 3 days, to shake 10 acres by hand.

The "Caterpillar" Diesel Tractor has inspired considerable equipment development. It goes where it's steered, when it's asked. It is built to carry and power mounted equipment on front, sides or rear. Its horsepower bonus is a constant invitation to combine farming operations or increase machinery capacity.

These features are a challenge to machinery-designing progress in the farm shop as well as in the Agricultural Engineering Development Laboratory.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

**CATERPILLAR DIESEL**

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**ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT**

AGRICULTURAL ENGINEERING

Vol. 26 APRIL, 1945 No. 4

# Water Policy in Relation to Western Agriculture

By Hon. Claude R. Wickard
Secretary of Agriculture

THE extent of the responsibility of the United States Department of Agriculture and the War Food Administration in the development, use and disposal of water is obvious. Water and good soil are the two great natural resources that must be present to make productive farming possible. In extensive portions of the country such a combination occurs naturally; but there are large areas of good soil where men must either bring water to the land or drain it off before agriculture can become stable and prosperous.

Action to bring in more water than local rain and snowfall provide is of particular importance throughout great stretches of the West. In these areas, an adequate and realistic agricultural program includes active measures for providing water and controlling its use, and it is with this problem that this statement is concerned.

CLAUDE R. WICKARD

Two fundamental principles underlie the Department's water policy for the West. One is the conviction that the ultimate goal of every irrigation project must be the welfare of the families who make their homes on the land. The other is the conviction that a water policy, to be fully effective, must be part of a comprehensive policy for wise use of all of the Nation's natural resources.

The great engineering skill that goes into the construction of dams, aqueducts, power plants, or other facilities must be matched by agricultural and other skills in putting them to productive use. Such developments must be of value to the people of the areas they serve. An irrigation system, for instance, should be a means of helping farm families to make their operations more stable and more profitable so that their level of living will be higher and more secure. At the same time, it should enable the farm people it serves directly to produce more of the things people of their own communities or other parts of the country need and want. Furthermore, no individual project should be so constructed or operated that it would have repercussions in other areas that would counterbalance the benefits to the people immediately benefited.

These considerations of human welfare lead directly to the second major objective of western water policy — integration with a broad natural resources policy for the region and the Nation.

Water available in dry areas can serve many purposes, such as livestock and farmstead supplies, municipal, industrial and mining uses, in addition to irrigation and hydroelectric power, and, in some cases, navigation farther downstream. Even in the sections of the West with the least rainfall, water often can be destructive. Hence, each stream should be viewed in relation to the needs for flood control all along its course. Obviously, the greatest benefits can usually be obtained from a water supply by integrating its use for as many purposes as possible. Often the water supply which is used to generate hydroelectric power for farm and urban use also can be used for irrigation, and a reservoir used for storing water for irrigation and power often can be so constructed and operated as to provide protection against floods.

Needs of industry and commerce and different kinds of agriculture are tied in closely. The forests that protect upland water supplies, for example, yield lumber for buildings on land irrigated by that same water downstream. Hay and forage grown under irrigation supplement range land grass. The areas of grass that support livestock protect the watershed and safeguard downstream agriculture. If the range is overgrazed, failing supplies of supplementary feed and increased flood damage downstream are among the unhappy results.

It is impossible to separate one use of water from the others, or water policy from agricultural policy as a whole.

In the past, irrigation and other water developments have not always done as much as they might to advance the welfare of people and to fit into a nation-wide pattern for wise use of natural resources. There has been a marked trend, however, in these directions.

Many of the earlier projects, dating from far back in the last century, were undertaken by the people of an immediate area for one specific purpose, with little regard to effects elsewhere in the watershed or to wider opportunities for benefit. As long as operations remained on a small scale, results of so limited a viewpoint were not so serious as they became when larger projects were planned to take in more territory, use more water and serve more people. The technical advance in engineering skills for storing and transporting water tended to run ahead of gains in the broader fields of agriculture and economics that would have enabled the wisest use of the water made available. It took time also for many people to realize the value of the broad, long view.

The gap between what ought to be done and what is done has not yet been closed, although it is narrowing. Unsuitable lands have been irrigated; adequate water has failed to materialize; costs to farmers have outrun benefits; farm settlers have been stranded in untenable circumstances; harmful patterns of land use have been fostered. In most instances, these misfortunes trace back to ill-considered action—to failure to study each potential development from all sides and take full account of all its implications. Responsibility for errors of omission or commission has been widely distributed among public agencies and private groups and organizations. For the most part, however, irrigation projects have tended to be more carefully planned as experience showed the way, and the good results are noticeable.

The Department of Agriculture, with its definite responsibility for production of crops and livestock and for measures to prevent erosion and reduce flooding of agricultural land, thereby shares the responsibility for the development, control, and use of the national water resources and is deeply interested in other uses of water such as the production of electric power and improved navigation that affect farm living and the handling of farm products.

Basically, the Department's water policy aims at the fullest and wisest use of water by the people immediately affected, with due regard for the present and long-range interests of all agriculture and of the Nation as a whole.

Specific procedures for carrying out this central policy vary with different situations. Where farmers need more water than rainfall provides naturally, there are cases where individual farmers or small groups of farmers can best take responsibility for obtaining the additional water, and there are others involving larger operations

This is an address delivered before the Washington (D. C.) Section of the American Society of Agricultural Engineers at Washington, D.C., February 9, 1945.

Farming in many parts of the West and also in other areas of the country, where normal rainfall will support some agriculture, will be more stable and more profitable if further steps are taken to conserve available water supplies and to use them better and to develop additional supplies. In the main, farms in these areas need more adequate supplies for livestock and domestic use, and for irrigating home gardens and small feed acreages.

In these situations, the development and use of water resources is largely a problem of farm management. The Department of Agriculture has the responsibility for helping all farmers who require assistance in this field. It already is acting to discharge that responsibility by the coordinated operation of various congressionally authorized programs. The Agricultural Adjustment Agency makes payments to help farmers build small stockponds, dams and reservoirs. The Farm Security Administration, through the water facilities program, provides loans and technical assistance to individual and small groups of farmers in the arid and semiarid areas for building ponds and wells, developing springs, building tanks and windmills, installing pumps, rehabilitating and constructing small irrigation systems and otherwise developing and utilizing water.

The Soil Conservation Service, through its technical assistance to farmers in soil conservation districts, has done much to stimulate better use of water and a consciousness for the need of structures properly designed to bring about the most practical use of water and land. The Forest Service is doing work of inestimable value in maintaining and improving the watersheds through forestation, reforestation, and range improvement.

The Department of Agriculture intends to continue and expand all such assistance to individual farmers and small groups of farmers, not only in the West, but wherever it is needed.

In large-scale operations, where responsibility for the engineering works to bring water to the land rests with other agencies than the Department of Agriculture, this Department has definite and long-range responsibility for the farms and the people and has definite principles for furthering them. In connection with many projects, the principal engineering portions of which are constructed by the Bureau of Reclamation, the Department of Agriculture, under the provisions of the Wheeler-Case Act, handles the unit adjustment, agricultural development and settlement phases and assists farmers in making effective use of available water.

In relationship to the larger water-development projects, the Department's operating policies have been shaped to fit three major types of situations.

First, there are the irrigation and other water projects that already are in existence. On the 21 million acres now under irrigation it clearly is the Department's job to do everything in its power to help farm people make the best use of the available water. The Department has the same obligation to irrigation farmers as to all farmers, in dry or humid areas — obligations that touch on efficiency of production and marketing, levels of price and income, tenure, and so forth. Farm people of nearly every part of the country have their own sets of local problems; those problems in irrigated areas concern water in addition to the others. The whole water supply for an area, for instance, may become inadequate, or facilities for making water available to individual farms may break down, wear out, or become obsolete. Especially in the older irrigated areas, lower-lying lands may be waterlogged so that drainage is needed. Or special economic problems may exist, such as charges to farmers for water being out of line with benefits.

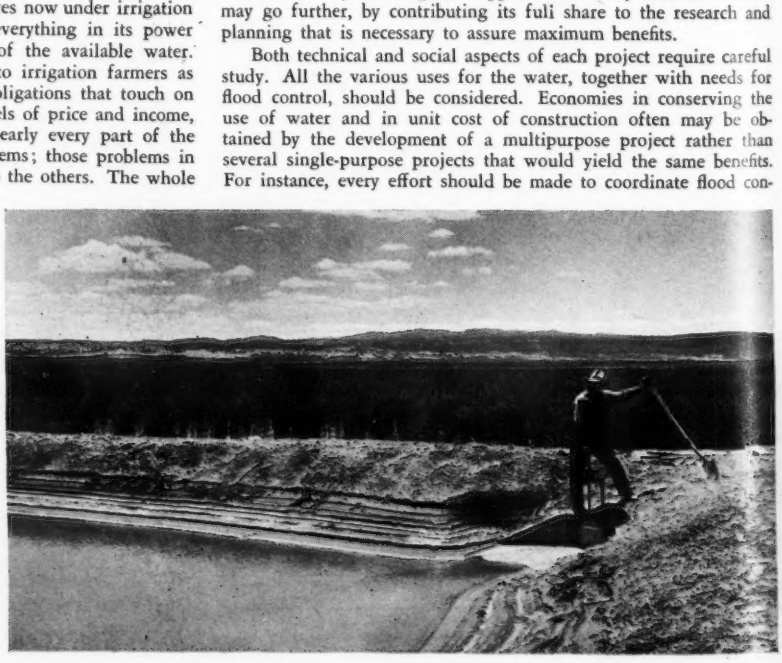
The Department has long been working in a variety of ways to help meet the special needs of farmers on irrigated land. Its research activities, many of them in cooperation with State experiment stations, have provided much information on the application of water and the management of irrigated farms. Leveling of land for irrigation and preparation of lateral ditches and outlets are part of the Department's program for the West. So is weed control, which plays an important role in improving the use of irrigated land. Payments are made to farmers for carrying out these practices. Also, the Department, in helping soil conservation districts to assist farmers, provides technical assistance and some equipment to aid in leveling and ditching. It also provides loans to farmers to enable them to make better use of existing water supplies. Programs for improving range and forest cover on the national forests build up underground supplies and protect the irrigation water supply at its source as well as help guard against floods downstream. Educational work is carried on cooperatively with the states to encourage farmers to apply improved methods of using water. Annual snow surveys are made to help forecast water supplies for the year in most of the western drainage basins by measuring the depth and water content of the snowfall in upland regions. Economic and physical research relating to all phases of farming affected by water use is carried on.

All of these varied efforts to aid farmers in irrigated areas should be continued, increased and broadened.

Second, there are the irrigation projects of various agencies that have been authorized but construction of which is either incomplete or not yet begun. For example, the Department of the Interior has as many as 40 such projects, which when completed are expected to irrigate about 2.8 million acres of new land and to bring supplemental water to about 5.7 million acres which now have an inadequate water supply.

The over-all responsibility of the Department of Agriculture in relation to these projects is similar to that for the completed ones. The general questions of feasibility and desirability from an agricultural standpoint are not now at issue. Many of the projects are multipurpose and all have been authorized. The water will be brought to the land. The Department expects to help farmers make the best use of it through the approaches already outlined. But it may go further, by contributing its fuli share to the research and planning that is necessary to assure maximum benefits.

Both technical and social aspects of each project require careful study. All the various uses for the water, together with needs for flood control, should be considered. Economies in conserving the use of water and in unit cost of construction often may be obtained by the development of a multipurpose project rather than several single-purpose projects that would yield the same benefits. For instance, every effort should be made to coordinate flood con-



**The proper application to the land of water delivered from major reservoirs and the development of the water supply in smaller irrigation reservoirs are the concern of the Department of Agriculture**

trol with storage of flood waters for future use. In further support of downstream benefits, careful consideration should be given to proper care of watershed lands, to soil conservation, and other practices designed to sustain and modify runoff and streamflow.

Irrigation projects must be so plotted and organized as to make new land available in adequate family sized units, and to give settlers reasonable prospects of success. Farm layouts, crops and types of farming adapted to the area, and the integration of the irrigation agriculture with the surrounding dry-land agriculture are just as important to success of a project as the location and design of engineering works.

The cost of water should not be greater than can be paid from the additional proceeds received from farming the land under irrigation, with due allowance for a reasonable standard of living for farm families. Flexible schedules for annual repayments on the costs of construction related to fluctuating farm returns would make water charges easier for farmers to meet and should result in a better repayment record. Speculation in raw land due to its prospective increased value because of a project should be prevented so that the increased cost of land may not offset the benefits from irrigation.

Settlement of a new area involves great problems. The old-time pioneering days are gone. Settlers on the frontier used to have a few years in which they were largely remote from the rest of the world. Now families on new land have to take their places immediately in the Nation's complex economic structure. Yet a lot of pioneering still has to be done on newly irrigated land, and developments that formerly took two generations must be crowded into a decade. Leveling the land for efficient irrigation, constructing the farm irrigation facilities, establishing field and farmstead layout, clearing and breaking out the land, selecting crops and getting them started, and constructing fences and buildings impose a host of problems on settlers.

It is important that settlers get started on a sound and efficient basis, for the pattern established in the first two or three years of settlement may remain for a generation and be altered only with great difficulty and at considerable expense. On large projects there are acute community and group problems relating to such enterprises as establishing roads, towns and schools. Many settlers will need technical and financial assistance in coping with their difficulties.

The Department is aware of these problems and anxious to help solve them. Through its authorities for and operations of the tenant purchase and other programs, it is staffed and equipped by experience to advise and assist prospective settlers to locate themselves and actually get established. These and all of the other Department programs for helping farmers can be of maximum benefit if their possibilities are considered before the water is brought in. The scope of these programs should be broadened to put the Department in a position to help farmers get off to a good start on all new land. The Department is anxious to cooperate in every possible way toward making new projects of maximum benefit to the farmers of the area and the Nation as a whole.

Third, there are new projects, either those under discussion but not yet authorized, or those to be proposed in the future.

The Department of Agriculture believes that top priority for new water developments should go to projects for bringing supplemental water to areas that already are being farmed but have inadequate supplies. Also, the Department is in favor of bringing new land into production when it is suited to agricultural use and when its cultivation offers irrigation farmers a reasonable prospect of success and appears to be in the national interest. The Department feels that it can aid materially and should participate in making these basic determinations.

Much of the over-all planning already mentioned would be of the most use if it were done before a project is authorized. Information on the kind of agriculture that probably will be practiced on the new land, and on ways of getting farm families started, are highly relevant to the desirability of a project. It is essential that over-all planning include adequate and thorough soil surveys and classifications, and evaluation of the benefits to be obtained from irrigation.

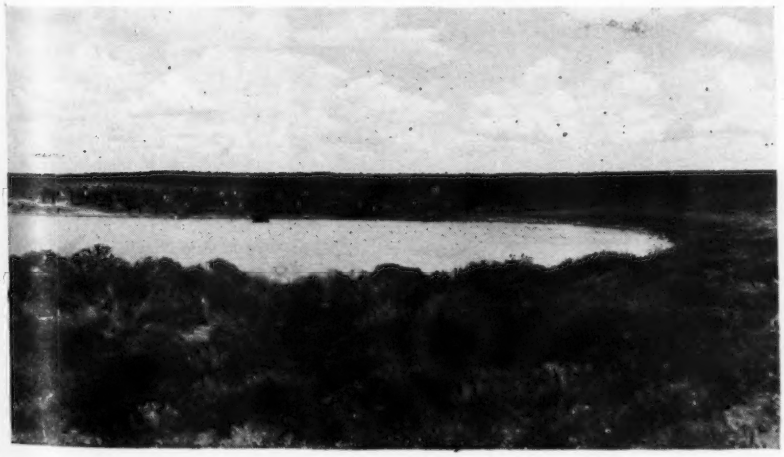
In particular, a firm estimate of direct and indirect benefits to people of the area is needed as a basis for determining the probable schedule of charges to beneficiaries. If a project has one or more purposes besides irrigation, the first step must be a decision as to what part of the total cost shall be charged to irrigation and how much to the other uses. The next step is to determine if all of the irrigation cost should be borne by farmers, and if not, how much should be charged to other beneficiaries or the Nation as a whole. Under no circumstances should farmers be charged more for irrigation than the water is worth to them. Nobody gains when the farm cost of water is higher than farmers can afford. The general public winds up bearing the excess anyhow, and the chief difference from starting out with a reasonable rate schedule and establishing it on some future date is that a generation or two of farm people have worn themselves out trying to meet excessive charges in the interim.

The Department of Agriculture is in favor of a wise policy of bringing in new land. Assuming normal population growth, a rising standard of living and abandonment of "worn-out" and submarginal land, it is reasonable to suppose that some day all of the Nation's potential good farm land will be needed. The chief considerations that should determine the wisdom of a proposal to bring in new land follow.

New projects should be studied from the national and regional, as well as the local, viewpoints. This is in the interest not only of the general welfare, but also of the people of the local area, for in the long run the success of each project is largely dependent on how well it fits in with national production, demand and transportation of farm commodities.

The relationship of new farm land to become available through a proposed irrigation project to the volume of farm land which may become available through drainage and other land improvement activities, should be considered.

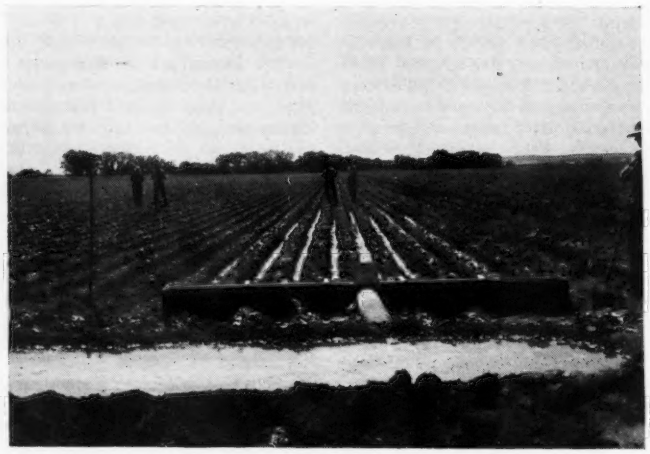
The desirability of developing new agricultural land should be



**Availability or lack of water for livestock determines the success or failure of cattle ranches in the West. The Department of Agriculture through several of its agencies aid such water developments**

balanced against probable domestic and foreign needs for our farm products.

A recent analysis of agricultural production and consumption possibilities indicates that, if this country achieves full domestic employment and maintains a moderately active foreign trade in the years after the war, there will in all probability be a need for a total agricultural production considerably larger than that of the prewar years. How many acres of new farm land may be required to supply this increased agricultural production depends, in great measure, on future improvements in farm technology. We have greatly increased our ability to produce food from a given acre of land in the past few years; and we have learned much about how to keep our soil from deteriorating and our land from becoming useless for farm purposes.



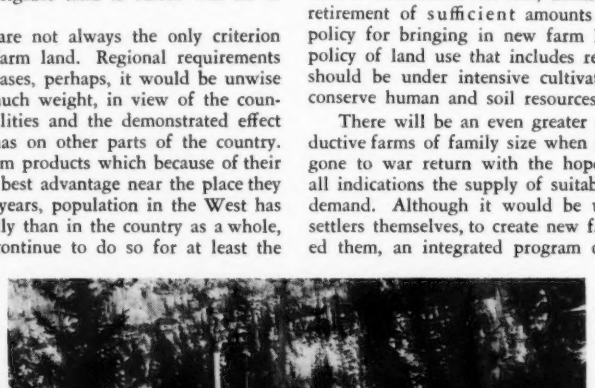
Research agencies of the Department of Agriculture conduct studies to develop improved methods of water utilization. This picture shows an experiment conducted by the Soil Conservation Service, in cooperation with Colorado Agricultural Experiment Station, to determine the time of travel of water in irrigation furrows

With less than full employment, demands for food and fiber would be smaller. With less than the expected volume of foreign trade they would be smaller still. If farmers permit themselves to be priced out of domestic or foreign markets, the long-range demands for farm products would be shrunk even further. Realistic efforts to bring in significant amounts of new farm land call for vigorous action along all lines to expand farm markets, as well as to maintain full non-agricultural employment.

Total production is by no means the only consideration. Whatever the over-all trend in requirements may be, there will be marked differences in demand among various products. Thus the type of production for which irrigable land is suited will be of great importance.

Also, national requirements are not always the only criterion for judging the need for new farm land. Regional requirements can be significant too. In most cases, perhaps, it would be unwise to give regional situations too much weight, in view of the country's excellent transportation facilities and the demonstrated effect that production in one area has on other parts of the country. However, there are numerous farm products which because of their bulk or perishability are used to best advantage near the place they are produced. For a number of years, population in the West has been increasing much more rapidly than in the country as a whole, and it is probable that it will continue to do so for at least the next 15 years. This trend should be considered in appraising the wisdom of new irrigation projects.

Furthermore, the time lag in bringing irrigation projects into operation needs to be considered. For large enterprises, it takes years or even decades to do all the necessary planning and construction work, to settle new people and get all the land into production. The requirements of the moment, or the probable needs of the near future are not the only guides to the wisdom of starting to bring in new land. We must not be afraid to plan boldly for wide use of our resources even when no immediate use is in sight.



The Soil Conservation Service conducts snow surveys in cooperation with the state agricultural experiment stations and other interested agencies for the purpose of forecasting water supply for irrigation

The need for integrating new irrigation developments, particularly in the Great Plains, with existing dry-land agriculture should be considered with a view to providing a maximum number of dry-land farmers or ranchers with some irrigated land for feed production and other special uses. This development would offer dependable sources of supplementary income and help farmers and ranchers weather periods of drought. This practice makes not only for efficient use of available water, but also for reduced costs to individual farmers. It can aid in the development of a more diversified agriculture for the maximum number of farms in an irrigation area and thus help open the way to a more stable farm economy there.

Also, in estimating how much farm land we will need in the future, it is not enough to start with the mere number of acres we have now and assume that they all will stay in production. Thousands of farms now being operated are so poor that they cannot yield adequate family incomes. Some of these lands should be put to less intensive use, such as timber or pasture. Other portions could be reorganized into farms of sufficient capacity to support a family. Present occupants of such land should be given opportunities on better lands or in other types of enterprises. Thus, although an acre of good irrigated land has many times the productive capacity of an eroded "farmed-out" acre, the opening up of new land would not necessarily represent a net increase in the Nation's or region's agricultural plant when the retirement of old land is considered. In fact, balance could be maintained through retirement of sufficient amounts of submarginal land. National policy for bringing in new farm land should be part of a broad policy of land use that includes retirement of land that no longer should be under intensive cultivation as one of the measures to conserve human and soil resources.

There will be an even greater stimulus to the demand for productive farms of family size when many of the farm boys who have gone to war return with the hope of entering agriculture. From all indications the supply of suitable farms will run far behind the demand. Although it would be unwise, and most unfair to the settlers themselves, to create new farms solely because people wanted them, an integrated program of retiring "worn-out" and submarginal land and opening new good land can help, at least, to meet the needs of qualified veterans and some others.

Those are the main attitudes behind the Agriculture Department's support of well-considered plans for bringing in new land through water development and drainage and its interest in getting from existing water projects the maximum benefits to land and people. Each water project can realize its fullest possibilities through integration with the total agricultural pattern. Just as certainly, no national program for better farming and wise land use can overlook the importance of developing water resources.

# Agriculture's Safety Challenge

By C. L. Hamilton
MEMBER A.S.A.E.

MOST people think of a farm as a quiet, safe place compared to the City. Noisy factories, shops or mills seem much more dangerous than a corn field or a quiet farm home, but accidents take the lives of more farm workers than are killed in any other industry. One may wonder why this toll is so great. The majority of farmers and agricultural leaders have done very little about accident prevention. As a result, a terrific toll of farm accidents has been piled up. What may be extremely hazardous is taken for granted because it has always been that way.

The seriousness of the farm accident problem can be realized better when it is known that during 1943 all types of accidents cost agriculture about 17,200 deaths, 1,500,000 non-fatal injuries, 25,000,000 man-days of work and, worst of all, inestimable human suffering. The deaths and injuries alone represent 47 funerals a day and enough man-days of lost time to produce the entire wheat crop in this country during an average year. It is estimated that the cost of accidents and fires on farms including medical expense, insurance overhead and reduced crop production exceeds $1,000,000,000 annually.

Over two-fifths of the total, or 7500, fatalities are caused by farm home accidents; almost one-fourth, or 4500, are the result of farm work accidents. Public motor-vehicle accidents account for almost one-fourth and the remainder are other public accidents such as hunting and drowning. The records indicate that, if you work in agriculture, your chance of an accidental death is over twice as great as when you work in either the manufacturing or the trade and service industries. Only construction, the mining and quarrying or the transportation and public utilities industries have a higher accidental work death rate than agriculture.

Such a toll of death and disability from preventable accidents should not be tolerated. Accidents are avoidable. Some industrial concerns have succeeded in practically eliminating accident losses with common sense preventative programs. Farm accidents can be reduced just as dramatically if accident hazards and unsafe working habits are eliminated on every farm. Most of the remedies are simple, inexpensive and obvious. The principal requirement is determination to really do something about making our farms safe. Farm safety has been a talk-much and do-little subject long enough.

*The Challenge.* If farm accidents are to be reduced, it will be necessary to reach most of our 6,000,000 farms and the 30,000,000 people that live on them. We must reach them not only once but again and again and again. Many of their every-day habits of living, work or play must be changed. This is a tremendous task. There are over 9,000,000 adult farmers whose work practices have become deeply rooted by years of repetition and tradition. There are nearly 8,000,000 adult farm women whose homemaking practices are equally well established.

Farmers rule their own domains; they are widely scattered and slow to accept changes. There is no safety engineer on the job, as in industry, to eliminate accident hazards or forestall acts of thoughtlessness and carelessness. In agriculture, other methods must be used. All available resources must be utilized.

Fortunately the largest group, approximately 13,000,000, are the farm boys and girls. This group does not have so many unsafe practices to unlearn. They are more susceptible and accessible to safety education. Their work and education has a distinct influence on their parents. There are nearly 19,000 high schools with departments of vocational agriculture and 500,000 4-H clubs in the United States. There are about 250,000 farm women groups throughout the country, approximately 75,000 rural organizations and over 200,000 rural schools. These are some of the channels through which farm safety must be carried.

Personal habits are not all that have to be changed in the interest of farm safety. Farm structures, of which there are nearly 38,000,000, incorporate many accident hazards at the present time. Farm machinery and other equipment present similar problems. There are nearly 2,000,000 tractors and over 60,000,000 other field or farmstead machines. Two and one-half million farms are now serviced with electricity and all its appliances. The farm trucks, trailers, automobiles, guns, livestock and other items that may contribute to accidents also run into the millions.

No single organization, no matter how large its budget, can do the job alone. If safety is to be integrated into the daily life of farm families, the most important people, the most influential organizations, media or agencies for shaping opinion must get into the drive. If all the agencies that influence farm life work together in behalf of accident prevention, real results can be expected. Besides industry and established agricultural agencies, thousands of volunteer workers will be required to do the ultimate job. This army of volunteer workers or local leaders will be as vital to final success as they are in Red Cross programs, 4-H Club work or war bond sales.

The National Safety Council in itself can only do a small part of the work that must be done for effective results. It is up to other organizations and interests — national, state and local — industrial and governmental—large and small—to carry the message of safety down to the individual farmer. The Council functions as a planning, stimulating and coordinating agency. It acts as a clearinghouse for improved techniques and methods. It assists in the collection, preparation, and distribution of educational materials such as literature, posters, statistics, exhibits and visual aids.

To facilitate the efforts of cooperating groups at all levels, state and local farm safety committees are being organized. Many states have already established safety committees to get teamwork started. All local agencies which can contribute to farm safety are usually represented on these committees. They pool their resources, plan and direct state or county safety programs. In the last year 4 or 5 states have employed full-time farm safety specialists to follow through on established programs.

*A 4-Point Program.* Farm safety is a four-point program: (1) statistics, (2) techniques, (3) education, and (4) action. Where all phases of the job are integrated, results can be expected if the work is carried out with persistence and thoroughness. Each organization or agency should select a part of the program where they can make the greatest contribution and coordinate their activities with others to round out a complete state or county program.

Farm-accident statistics which show the type and causes of accidents in any state or community is a basic step. This information will show what is happening, what must be done and serve as a yardstick for measuring accomplishments. Developing methods of securing this essential information through schools, clubs, clippings, doctors, census or other surveys is no small undertaking. Developing accident prevention techniques and recommendations is another basic requirement for any sound safety program. The multiplic-

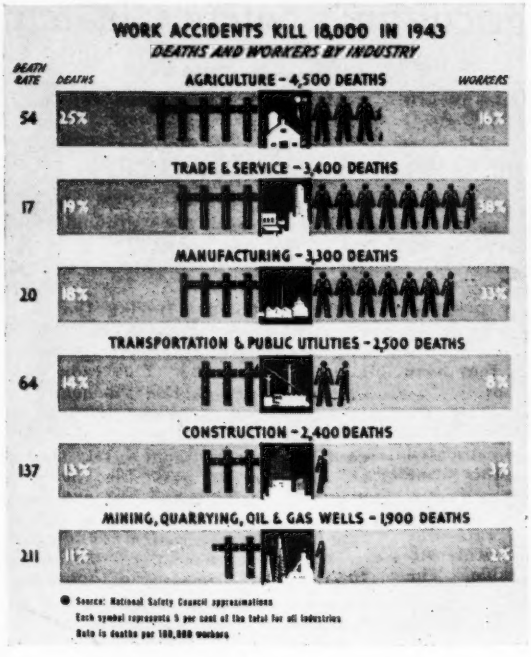
This paper was presented at a meeting of the Southeast Section of the American Society of Agricultural Engineers at Atlanta, Ga., February, 1945.

C. L. HAMILTON is agricultural engineer, National Safety Council

ity of farm jobs, tools and equipment indicates the size of this phase. This phase is basically an engineering job where agricultural engineers can make their greatest contribution.

Safety education is the big job where all agricultural agencies have much to contribute. Little improvement can be expected until farm people become safety conscious. Some may say that statistics and techniques should be developed before launching educational activities. The need for safety education is so great and the job so big that it cannot be delayed. We must attack all parts of the job simultaneously. Action or results is the ultimate goal. Action in locating and eliminating hazards or in forming safe-working habits on each individual farm.

Safety principles and practices must be developed and taught as an integral part of each farm job. They must be completely dovetailed into farm work so they are readily accepted as a part of the job. Accident prevention will not be accepted where safety programs are maintained as a separate or parallel activity to other projects. This means that everyone who conducts agricultural educational work has a responsibility to see that the safety phase of a project is not overlooked. Assuming that someone else is responsible for safety is an easy way of delaying farm accident reduction.



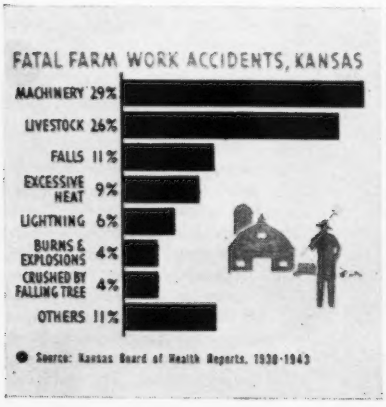

*Agricultural Engineering Contributions.* Can any group as vitally interested in the future well-being of agriculture as agricultural engineers afford to see thousands of farm people killed or disabled and a billion dollars wasted annually from accidents? This is a symptom of social backwardness. Death, permanent disability and loss of productive time are common enough through natural causes and need not be augmented by human failure. Agricultural engineers can make a worth-while contribution to all phases of the program, but the development of safety devices, techniques, and practices will be their primary responsibility. Those in extension, teaching, research and industry have corresponding farm safety obligations.

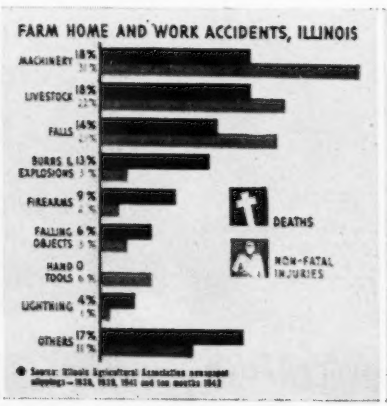
Agricultural engineers have not stood idly by and done nothing about accident prevention. Anyone who has followed the activities of members of the American Society of Agricultural Engineers can already point to worthy contributions. The industry group that standardized tractor power take-offs and provided uniform shielding is an outstanding example. Improvements have also been made in shielding other parts of farm machinery. F. W. Duffee's pioneer work in developing the Wisconsin safety code for electric fence controllers and a safety hitch for tractors are other examples. The group of engineers that have been researching long hours to develop safe methods of storing high moisture content hay or grain are solving fire hazards as well as saving farm crops. Those developing fireproof construction and safe electrical wiring methods for farms are making other contributions. The safety education covered in the classrooms and in extension projects can also be mentioned.

In the main, agricultural engineers have concentrated on some of the big problems related to safety. Those were the solutions that required considerable research, skill and ingenuity. In our enthusiasm to solve intricate problems I believe we have neglected many of the common farm hazards. Common hazards account for the largest portion of farm accidents. They are the pitfalls which farmers encounter several times a day. Failure to do something about these common hazards and habits leads to the same general type of accidents year after year.

In some of the midwest states where farm accident surveys have been made, nearly half of the fatal and non-fatal farm machinery accidents involve careless operation of tractors. In spite of this record, safe operation is frequently overlooked or forgotten in tractor repair and servicing schools. Of course, some work has been done both in extension and by manufacturers but the problem has not been given attention in proportion to the size of the job. The number of tractor accidents seems to be increasing instead of decreasing. Somewhat the same condition can be cited for other farm machines in the high-accident group such as corn pickers and shellers, combines, circular saws and mowers. Many college bulletins have been prepared on machinery adjustment or repair, but I doubt if anything on safe operation is included. What have we done to reduce circular saw accidents? Have we even developed recommendations on how to saw wood safely? The farmer is usually left to his own resources. Instances could be pointed out where we have either encouraged or sanctioned the construction of homemade equipment that is actually hazardous. Frequently more attention has been given to the protection of an implement than to the protection of the operator; safety plow hitches and lubrication systems are examples.

The farm structures group has an *(Continued on page 148)*



# Flame Cultivation of Row Crops

By P. W. Gull

WITH the mechanical cotton picker becoming a reality as a farm machine, the need for a large labor supply to harvest the crop becomes unnecessary. About 40 per cent of the labor required to grow and harvest a cotton crop is used in seedbed preparation, planting, hoeing, and cultivation, and 60 per cent for harvesting. When harvesting is done mechanically, the year-round labor supply will be thrown out of balance. Having this in mind and also the need for lowered production costs, so that cotton can be produced at a price whereby it can compete with synthetic fibers and foreign growths, the Mississippi Delta Experiment Station has initiated an extensive cotton mechanization program.

Production costs can be greatly reduced through the use of tractor equipment. The techniques and methods of using available tractor equipment for cotton production needs much study and thought on the part of experiment stations, farm implement companies, and farmers.

At a recent group meeting, sponsored by the Delta Council and attended by representatives of several machinery manufacturers, members of the staff of the Delta Experiment Station and Mississippi State College, and farmers from Arkansas and Mississippi interested in mechanical cotton farming, means and methods of seedbed preparation, planting and cultivation of cotton were discussed. The discussions were predicated on the assumption that the cotton picker is a reliable farm implement. Development of ginning machinery and marketing and spinning facilities for handling machine-picked cotton is mandatory if the picker is to be utilized to the fullest advantage.

The theme of the discussions was how best to use present planting and cultivating machinery to eliminate hand work in growing cotton. Some of the methods mentioned were check planting and cross cultivation, drill planting and cross plowing, and drill planting to a stand. The use of a rotary hoe in controlling weed growth in the rows or hills was also discussed. The point was brought out that at present no tillage implements are available either in production or an experimental stage of development that will completely control undesired plant growth in the row from planting to harvest.

It was with this thought in mind that the Delta Experiment Station accepted the opportunity to work with the Fijelen Research and Development Company in applying flame for the control of weeds and grass in cotton.

The work in 1943 was done by Dr. J. Winston Neely and Sidney G. Brain. The machine which they used was a sulky-trailer type on which was mounted an air compressor, gasoline motor, and fuel tank. Four burners were mounted on three skids that dragged behind the sulky. The burners were mounted so that the flame was directed downward and across the row of cotton, one burner on each side of the row, and two rows were flamed in one operation. The burners for each row traveled on opposite sides of the row and were in tandem, thus the flames did not oppose each other and flare up into the plant. The burners on this machine were of the oil-air type whereby the fuel was pumped from the tank to the burner, and the air was under 60 lb pressure. Pilot lights were provided to ignite the burners. Considerable difficulty was experienced in keeping the burners lighted during field operations.

Mississippi Farm Research, February, 1945, describes the 1944 machine as follows: "The 1944 machine was considerably improved for operation under Delta conditions. Tractor mounted, fuel was delivered under gravity instead of being under pressure; this eliminated certain troubles in burner operation. The air compressor was driven from the power take-off, eliminating necessity for a motor. The addition at the Delta station of a spark plug in each burner head, a distributor driven from the shaft of the compressor, in conjunction with a coil and tractor battery, gave automatic ignition when the burners were cold, even with diesel No. 2 fuel. The machine was designed to carry an operator, in addition to the tractor driver, to keep the burners lighted and adjusted. Attachment of a power lift to raise and lower the burner assembly, in conjunction with automatic ignition, did away with the necessity of an additional operator.

"Another development at the station, in cooperation with the Fijelen Research and Development Company, was the use of flame for blocking cotton to a stand in the drill (Cotton and Cotton Oil Press, October, 1944). Five open-end metal boxes were attached to each of two cultivator wheels mounted on an axle. The axle serving as burner supports so that a burner is pointed toward the drill from each side, the wheels are pulled along the two rows. The boxes encase the cotton on about 5 in of row, shielding the young plants from the flame, with all plants unprotected exposed to the flame. Thirty-two acres were blocked successfully at a cost of 47 c per acre, exclusive of depreciation on machinery."

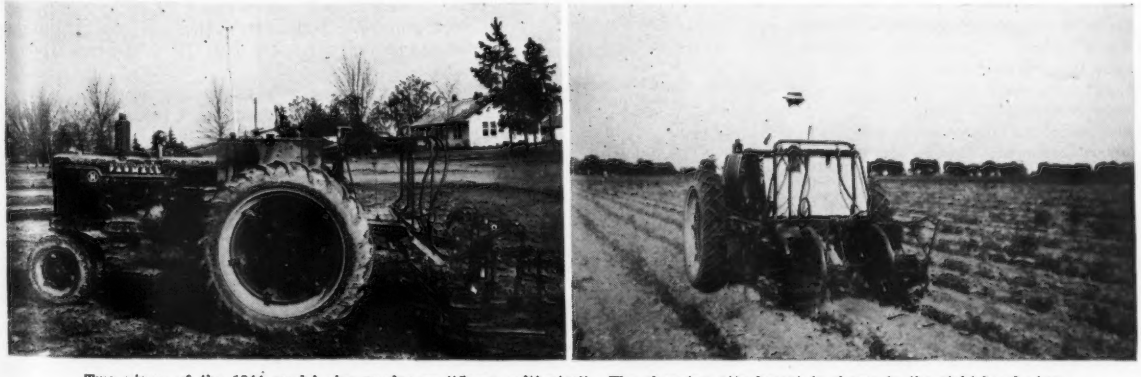
The following discussions of the work and results for 1943 are quoted from Mississippi Circular 118: "An experiment was set up in which four treatments were tested. The experimental design consisted of six series of four-row, 1/27-acre plots, arranged in simple randomized blocks. The two center rows were harvested for yield determinations. The four treatments were as follows:

Cultivation—no hoeing—no flaming
Cultivation—no hoeing—flaming
No cultivation—no hoeing—flaming
Cultivation—hoeing—no flaming

"All plots germinated on May 12 and were plowed three times and thinned and hoed once before the test was started on June 12. The cotton was 6 to 8 in high at the beginning of the flaming experiment. Each of the plots was heavily infested with grasses and weeds, principally crabgrass, 'watergrass', and careless weeds (*Amaranthus*).

This is a paper presented at a meeting of the Southeast Section of the American Society of Agricultural Engineers at Atlanta, Ga., February, 1945.

P. W GULL is agronomist, Delta Branch, Mississippi Agricultural Experiment Station.



Two views of the 1944 model sizz-weeder or "flame cultivator". The chopping attachment is shown in the right-hand view

"The cultivation—no hoeing—no flaming plots were cultivated June 15 and July 6 with sweeps on a walking cultivator. No additional effort was made to control weeds in the drill. At the time the first picking was made, the cotton plants were completely 'wrapped' in crabgrass; 'watergrass', a species of panicum; morning glory; and two other types of 'tie vines'. Some 'nut grass' and an occasional plant of Johnson grass were found.

"The cultivation — no hoeing — flaming plots were flamed on the beds on June 12, June 15, June 22, June 25, June 28, and July 2. The first four flamings were required to kill the mass of weeds and grasses at the beginning of the test. These plots were plowed on June 15 and July 6, but no hoeing was done after the test was started. At the time of frost the plots were practically free of weeds; only an occasional plant of crabgrass and morning glory and a very small amount of nut grass were found.

"The no cultivation—no hoeing—flaming plots were flamed on the beds on June 12, June 15, June 22, June 25, June 28 and July 2. The first four flamings were required to clean the plots, since the test was started with heavy weed and grass infestations. The middles were flamed on July 2. No hoeing or plowing was done after the test was started. There were fewer weed and grass plants than were found in the cultivated plots.

"The cultivation—hoeing—no flaming plots were cultivated on June 15 and on July 6, and were hoed on June 14 and July 7. A very large amount of weeds and grasses was removed in the first hoeing, and a considerable amount in the second hoeing. These plots were handled in the same way as the general crop, and the treatment may be considered as a regular plantation practice. The amount of weeds and grasses at the time of frost was small, but probably more than occurred in the flamed plots.

"The total yields of seed cotton for the four treatments are given in Table 1. Under the conditions of this experiment, no significant difference between the plantation practice and the flaming alone treatments or between the plantation practice and the cultivation and flaming combination treatments was obtained. A significantly smaller yield was obtained from the plots in which the weeds in the drill were not controlled than was obtained from the other three treatments."

TABLE 1. TOTAL YIELDS OF SEED COTTON FROM FOUR TREATMENTS IN A WEED-CONTROL EXPERIMENT, STONEVILLE, MISSISSIPPI, 1943, SIX REPLICATIONS, TWO CENTER ROWS OF FOUR-ROW PLOTS

| Treatment | Seed cotton per acre, lb |
|---|---|
| Cultivation—no hoeing—no flaming | 1506 |
| Cultivation—no hoeing—flaming | 2130 |
| No cultivation—no hoeing—flaming | 2033 |
| Cultivation—hoeing—no flaming (plantation practice) | 2141 |
| Difference barely significant | 196 |
| Difference highly significant | 271 |

The 1944 work with the sizz-weeder or "flame cultivator" was included in an over-all cotton mechanization experiment whereby drill vs. check, defoliated vs. undefoliated, hoed vs. flamed, and machine vs. hand picking were compared. The experiment was a split-plot factorial, with defoliation and drill and check making up the whole plots. These were arranged in two Latin squares making eight replications in all. In the hoed plots all thinning and control of weeds in the row were accomplished by hand. No thinning was necessary in the check stands, for either hoed or flamed plots. The drill cotton was thinned with the Dixie cotton chopper, but due to unfavorable conditions at the time of chopping, a very poor job was done. In order that thinning would not be a variable, these plots were "dressed up" by hand.

The average yield of seed cotton of drill and check for the hoed plots was 1190 lb per acre, and for flamed plots, 1133 lb. This difference is not large enough to be significant. All other factors measured, such as fiber length, fiber strength, grade uniformity, moisture content of seed cotton, lint and seed and spinning value were not affected. The free fatty acid content of flamed cotton was lower than for the hoed plots at the 1 per cent level of significance.

In this work no hand labor was necessary in checked and flamed plots. In the drill and flamed plots hand labor was necessary only for additional thinning. The plots were flamed from four to eight times, depending upon the type and amount of grass and weed infestation present. Both hoed and flamed plots received the same cultivation. At the end of the season the flame plots were as free of grass and weeds as the hoed plots.

Corn and soybeans have been flamed at the Delta station. Observations made indicate that corn can be flamed successfully at a rather young stage, and soybeans are rather easily injured even when rather advanced in growth.

In 1944 an attempt was made to determine the earliest possible date for flaming cotton. The conclusion from these observations was that cotton should be 6 to 8 in tall and the stem at the ground line at least 3/16 in in diameter. Plants 1/8 in or smaller in diameter definitely showed burning injury and stricturing.

Seven flame cultivators similar to that described above were in operation on Delta plantations in 1944. All users of these machines have reported favorable results.

## Agriculture's Safety Challenge

*(Continued from page 146)*

equal responsibility for safety in their field. Falls are one of the leading causes of farm accidents and it is estimated that many farmers spend at least half of their time in working around or in farm buildings. Accidents from falls are high in the farm home and in barns. In farm home planning little thought is given to developing safe stairways, porches, unobstructive lines of traffic or other safety features. Thousands of barn plans have been distributed to farmers, but I doubt if any safety features such as handrailed stairways to lofts, guarded loft floor openings, or safe platforms for servicing hay forks have been included. We have done little in developing or providing safe facilities for getting ensilage cutter spouts into 30 or 40-ft silos. Many other instances could be pointed out where we have neglected farm safety.

There has been improved structural designs developed for farm buildings, but invariably the simple safety trimmings for the protection of workers have been omitted or forgotten.

The rapid spread of electricity to farms adds new accident hazards; when used the wrong way, it becomes a death trap. The use of motor fuels, explosives and other combustible materials creates similar farm hazards. They have safety rules all of their own that must be followed on every farm. A farmer's safety responsibilities go beyond the boundaries of his farm. Public motor-vehicle accidents cause unnecessary suffering in too many farm families.

Members of the A.S.A.E. have the know-how to do the job if they elect to apply it. There is no other agricultural group that can contribute as much in the field of research and development of farm safety techniques as agricultural engineers. The home management and livestock specialists are other subject-matter groups involved in farm safety practices but the solution to some of their hazards in engineering — stairway design and safety bull pens — are examples. Engineering is so vital in developing practical solutions to most of the farm accident hazards that it can determine the failure or success of a safety program. Where safety recommendations are not sound or practical, educational activities become ineffective.

Farm work simplification is receiving attention in many states. As these studies spread to farm jobs that involve machinery, buildings and other equipment, safe practices become important as well as efficiency. Even finding easier ways to do farm work contributes to safety because it reduces fatigue. An overworked farmer doesn't have time to think, and if he doesn't think, accidents are bound to occur. Improving unsafe arrangements or work methods goes hand in hand with improving inefficiency. The man that gets things done is the man who places safety first. He is the man who devotes his time safely and skillfully.

We have made a good start in farm safety but we still have a long way to go. When the movement gains friends, strength, and prestige, the practice of safety will become more and more popular. Once a ball really gets rolling it can gather momentum fast. We know that accidents can be prevented. We have the technical knowledge and professional skills for the job. Gaining national acceptance of safety as an essential part of farm living and farm work is the real test facing agriculture.

We cannot draft men for this war against accidents. We can only ask everyone to volunteer — to become a participant and, according to his means, a contributor or sponsor. Let's see that no agricultural engineer shirks his duty. There may be no bands, no headlines or no songs to recognize those who do the ground work, but there will be a great humanitarian satisfaction if we make agriculture the safest place in which to work and live.

# The Postwar Farm Structures Situation

By K. J. T. Ekblaw
FELLOW A.S.A.E.

MORE than anything else, the purpose of this paper is to emphasize the importance of farm buildings, to discuss some of the factors that will affect the farm building situation after the war, and to advise you most earnestly that you must be ready after the war to help the farmer solve his building problems.

The building problem is one of the most serious with which the farmer will be faced after the war.

Changes of great magnitude have come to agriculture in recent years; changes in crops, changes in types of equipment, changes in methods and processes, changes in markets, changes in management, changes in living conditions and standards; but there has been little or no fundamental change in farm buildings for nearly a century. Because of this particular fact, it is reasonable to expect that changes in buildings may come with a rush; and with changes come problems.

The buildings on a farm are always an important part of it. Their importance is not generally realized or appreciated because buildings are not glamorous, because they stand so long in one place that we become used to them, and because no one takes time to consider the essential part that buildings play in sheltering crops, livestock, machinery and the farm family.

About one-third of the total value of real farm property in the United States is tied up in buildings. In a number of states, their importance as measured by their intrinsic value and by their advantages as essential equipment is much greater than the farm land itself.

According to the 1940 census, farm buildings in the United States are worth a little more than ten billion dollars, which represents a substantial reduction from the previous census value. The general trend before the present war was for a continuance of the lowering of values; use, decay and obsolescence were all helping such a reduction then, and the destructive influence of these three factors has been intensified during the war.

At various times different agricultural engineers have called attention to the serious deterioration that has been occurring in the physical plant of the American farm as represented by farm buildings. This deterioration has been especially marked in the last twenty-five or thirty years, beginning with the time of the first World War. Very little effective work was done to counteract depreciation in the twenty-five years preceding the outbreak of the present war; farm buildings deteriorated more rapidly than they could be repaired or replaced. The deterioration has proceeded at an augmented rate in the last three or four years because of the scarcity of materials and labor.

Now let us bring the picture home and see what it looks like.

In the eight southeastern states, including Virginia, North and South Carolina, Georgia, Florida, Alabama, Mississippi and Tennessee, a group of states of which Atlanta is in some ways the center, there are more than a billion and a quarter dollars worth of farm buildings. That amount presents present appraised valuation, which may be only a half or a third of their replacement value. These buildings constitute an investment four or five times as great as the investment in machinery and equipment in these same states. While a great stir is made about farm machinery these days, relatively little is said about farm buildings.

The reason I bring in this comparison between farm machinery and farm buildings is not because I wish to disparage the interest displayed in farm machinery. In fact, I am thoroughly in accord with the emphasis that is laid upon the importance of farm machinery and the part that it plays in crop production, but I must insist that agricultural engineers are failing in their duty when they neglect to consider the even greater importance of farm buildings.

Of what use is it to raise an extra hundred bushels of grain if it is to be lost by storage in a building with a leaking roof?

Of what use is it to increase production when we know that under present conditions four out of nine pigs farrowed never reach maturity because of inadequate and insanitary housing?

Of what use is it to develop and construct improved farm machinery, when as much as 50 per cent of the effective service life of such complex items as tractors, combines and harvesters is lost for the lack of proper and adequate shelter?

Let's determine to balance our thinking and our efforts and give this problem of farm buildings the attention it deserves.

You may be interested in knowing what is happening in one of your neighboring states. The following figures were given in a letter by Prof. David S. Weaver of North Carolina. During the ten-year period preceding the 1940 census, 77 of the 100 counties in North Carolina had a decrease in farm building valuation; in one of them the decrease amounted to $1,600,000; and this was during one of the most prosperous eras in the history of the state, in a county whose income from tobacco alone amounts to more than $15,000,000 per year.

In Missouri, which is not very much further north, a survey made in 1943, covering more than 400 farms in twenty typical counties, revealed that 73 per cent of the barns and 59 per cent of the other service buildings, were in need of immediate repairs. Repairs were impossible on 14 per cent of the barns and 16 per cent of the other service buildings, because the buildings were too far gone for repairs.

Going a little further north, and across the Mississippi River, to Illinois, a study made on the buildings of some 300 or 400 typical farms indicates that the average age of general-purpose barns is 49 years, none being under 20 years of age. These barns are 62.5 per cent depreciated, according to Prof. Deane G. Carter, under whose direction the survey was made. He estimates that on the average farm in Illinois the general-purpose barn will require an expenditure of $1,650 to restore its usefulness, to say nothing of an additional cost to revamp the barn for more modern use. When you are reminded that there are more than 250,000 farms in Illinois, you can see what a problem the farmers of that state are facing in just putting their barns into shape.

I have cited these figures and these examples to emphasize the fact that the postwar farm building situation is really a serious one for the whole country and for this section.

Competent authorities, estimating on a very conservative basis, figure that at least twenty billion dollars will have to be spent for rehabilitation or reconstruction

New and improved farming methods and processes require new and improved types of buildings, and designs for such buildings should be made in accord with their basic functional requirements

This paper was presented at a meeting of the Southeast Section of the American Society of Agricultural Engineers at Atlanta, Ga. February, 1945.

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of farm buildings for the whole country during the next ten years, which means a national expenditure of at least two billion dollars per year.

If that same ratio is maintained for this section, where you have more than a billion dollars worth of farm buildings, the ten-year cost of building rehabilitation and reconstruction after the war will be not less than two billion dollars or two hundred million dollars per year.

I sincerely hope that you will bear this figure in mind and think about it seriously. Of course a figure of two billion dollars seems small when compared with the tremendous figures we have heard in connection with war expenditures; but here we are, a group of thirty or forty agricultural engineers, who are going to have, or at least should have, a great deal to say and a great deal to do about spending two billion dollars. It is a job that is big enough to demand serious consideration from every one of us.

From the single standpoint of counteracting depreciation, see what the job looks like. Assuming that our farm buildings in this section are worth a billion and a quarter dollars, how much do they depreciate annually? What is a fair depreciation rate? Of course much depends upon the type of building and for what it is used, but four per cent should be a reasonable average. Four per cent of one billion and a quarter dollars is fifty million dollars.

If you, as agricultural engineers, are interested in stopping further depreciation of buildings, in conserving the investment which the farmers of the Southeast already have in buildings, there is a fifty-million-dollar job for you that has to be done every year. Is the job big enough to attract your interest? Are you big enough to be interested in the job?

Let's look at some of the other phases of the situation.

What will be the financial condition of the farmer when the war is over? From all indications he is going to be in a better financial condition than he has ever been before. His debts are going to be smaller; his cash and credit position is going to be better; and his savings are going to be greater than ever before.

Figures from the U. S. Department of Agriculture prove that expenditures for farm buildings and repair follow the same general trend as does farm income; that is, when farm income is good the farmer spends money for buildings; when his income is reduced his building expenditures are reduced. So it is natural to conclude that when the farmer has plenty of money he is going to spend money for buildings.

As a matter of fact, the farmer will have to spend a great deal of money for his buildings. Not only for repair and the rehabilitation of his present plant, but for the construction of many buildings which will be needed to meet the demands of new and better farming practices.

If two billion dollars must be spent in this section in the ten years following the war, who is going to guide the farmer in this expenditure, to insure that the money will be spent wisely and intelligently?

It is certain that there will be plenty of competition for the farmer's dollar; every branch of the manufacturing industry will be attempting to get its claws upon it. The farmer is not a building specialist; he will need advice as to how to spend his money in order to get the best buildings. Where is he going to get that help?

To determine the general viewpoint of agricultural specialists in the South toward the section's building problems, I made an inquiry of some twenty-five or thirty men in various fields — in crops, livestock, poultry. The results were very disappointing. Most of these specialists seemed to know very little about farm buildings, and apparently cared less. Of course, in the favorable climate of the South, buildings are not as vital as they are in some other sections; but the lack of interest and knowledge is, to my mind, deplorable.

Certainly the farm buildings of southern farms can be improved. Some of the steps toward improvement are basic and important, others are very minor and are important only in their universal application. Practically no one has any definite ideas as to the economy of farm structures, whether any are really needed or not, or if any are needed, what they should be like. The inability of farmers to pay for buildings, of almost any kind whatsoever, was generally emphasized, but financing seemed not to be a problem; ample funds were available for lending at favorable rates.

Will not the postwar period be a good time to correct conditions such as were described in one of the letters I received: "Our farm buildings are in a deplorable state. . . . One of our brilliant young farm leaders, a member of the state legislature, made the statement that the average value of the rural home in North Carolina was $445. If six people live in such a house, the cost is about $76 per person. Yet we would not want to build a dairy barn for that amount per cow. Are we raising our future citizens in structures not suitable for purebred cattle?"

No state in this section has more than one farm building specialist on its extension staff. In some states there is not even one man. True, each state has its farm building plan service, which will probably do a great deal of good, but it is impossible to reach a million farmers through this avenue alone. County agents know very little about farm buildings and can give little help. Manufacturers of building materials will render some service through their dealers, but we all know that such service is totally inadequate to the demand that will certainly arise. Something more will have to be done in this direction.

That brings up the matter as to what agencies will handle this matter of service to the farmer in solving his building problems. It is no secret that more than one governmental agency recognizes the extent and importance of the farm building problem and views with avidity the huge expenditures that are going to be made for building purposes in the farm field. What a juicy plum this would be to get control of! I don't know what the answer is to this problem. Agricultural engineers who are specialists in farm structures should be the ones who should be most interested in this particular matter, but the interest shown is deplorably low.

A dangerous factor in the postwar situation is the flood of new and untried building materials which is certain to flow into the farm field. Lumber, that old standby, is short in supply and is likely to continue so for some time after the war. It may be two or three years before an adequate supply of good building lumber reaches the farm. The same is true of steel. Some steel companies are seriously wondering where they are going to find enough steel for roofing because the demand for other types of steel products, that can be sold more profitably, is going to be so great. Substitute materials of various types are already on the market. Some of them have great value and merit, but others are untried and may not stand up under conditions of farm usage.

To continue with the material theme, there is another phase of it that may become serious. Heretofore the United States has been its own principal market for building materials. With new international viewpoints and systems that seem to be coming into vogue, we shall probably be compelled, for a time at least, to share some of these favorite types of material, short in supply as they may be, with other sections of the world. It is not stretching the imagination too far to say that it is entirely possible that the farmers in the United States will have to compete with the world for the materials necessary for the reconstruction and rehabilitation of their buildings.

The question of competent labor for the construction of farm buildings will have to be solved. Most farmers, fortunately, are able to do much of their own building; but the trouble is going to be for the farmer to find the time to do it. On larger buildings experienced help must be hired. Where will the farmer get it? City carpenters want the union wage scale which seems high to the farmers, and in fact they can't afford to pay it. The old-time, competent country carpenters, who were willing to work at reasonable rates, seem to have faded out of the picture.

Some authorities believe that considerable dependence may be placed upon returned soldiers who will have developed enough skill in carpentry to undertake building jobs successfully. It is possible that vocational schools can also contribute their share of workmen in the building field. Certainly little help will come from cities and towns, for the demand there for artisans promises to be heavy for years to come.

New and improved farming methods and processes will require new and improved types of buildings. The designs for these are not yet extant. New types of materials are fast coming into use and most farmers do not have the knowledge of how best to use them. Plywood, plastics, ceramics, new metals — all have possibilities; but who is going to show the farmer how to use them?

Probably some of you know about the Farm Structures Institute, an informal organization of agricultural engineers representing producers of basic building materials. Their purpose is primarily to improve the design and construction of *(Continued on page 155)*

# Mechanical Filbert Nut Picker

By F. E. Price and R. N. Lunde
MEMBER A.S.A.E.

THIS paper is more in the nature of a progress report on the work which has been done by agricultural engineers of the Oregon Agricultural Experiment Station on the development of a suction type filbert nut picker than a complete report on the project due to the fact that considerably more work is needed before a completely satisfactory machine is developed. We do, however, believe that considerable progress has been made. With the experience and results already established, the ideas now at hand give promise of a satisfactory solution to all the problems which at this time remain to be solved.

Mechanical picking of filberts and walnuts has been an intriguing idea to many growers and engineers for a long time. Relatively little has been done about it, however. Recent high labor costs and scarcities furnished a much greater impetus, and the demand for some kind of mechanical harvesting method became much more insistent. As a result, the decision to start on this project was made in the spring of 1943, and work was started in July of that year. Since filberts seemed at that time to offer fewer problems, and because the suction method of picking up the nuts seemed most feasible to us, we decided to try the suction method on filberts first. We hoped that if we could successfully handle filberts, we might possibly use the same type of equipment on walnuts.

The first part of this report deals briefly with the 1943 machine which was constructed and tested in the field. This first machine was built on a Ford tractor. The suction was provided by a Rembert type cotton suction fan mounted on the rear of the tractor and driven from the tractor belt pulley. This type of fan was chosen because at that time we did not know of any kind of device for removing the nuts from the air stream before they reached the fan. The Rembert fan has a perforated shield on the suction side of the wheel which prevents material of any size from getting into the blades; consequently, the nuts could go through the fan without being cracked. This fan had a 35x4-in, six-blade paddle-wheel mounted in a 9-in wide spiral case, the extra clearance being all on the suction side. The discharge was to the rear on the bottom.

The suction nozzles for picking up the nuts were suspended in front of the tractor and connected by means of flexible canvas cuffs, stovepipe and plywood ducts to the fan inlet. These nozzles were pulled along by a knee-action linkage which permitted them to follow the ground contour independently. They were carried about one inch off the ground by a glider shoe under the center of each nozzle. We found that three 15x2-in nozzles were all we had fan capacity to handle, due to insufficient power.

Since we were particularly concerned with learning if nuts could be picked up by suction, we spent little time on the problem of separating or catching the nuts. They were caught in a small trailer pulled behind, as they came out of the fan discharge. Plywood baffles in the trailer stopped most of the nuts, but also caught a lot of dirt.

After trying several types of nozzles, we finally found a design that worked quite well. It was made of sheet metal, with a straight vertical lift and a horizontal lip or skirt at the opening on both front and back sides. These cause the air to travel parallel to the ground, and the two streams of air from both front and back meeting under the nozzle opening create a very good lifting action. We found that the nozzles work best when designed to have a constant cross-sectional area, so that air velocities do not change. Also, the whole suction system should be designed similarly.

In order to get sufficient power to the fan, the tractor engine had to be operated at full throttle, and with such a high engine speed the ground speed in low gear was much too fast. By towing this tractor with another, we found that 1½ miles per hour was about the maximum speed permissible for clean picking.

The static suction as measured in these nozzles was eight inches of water when operating satisfactorily. However, static at the nozzles now seems to us to be of less importance than velocity. Well-designed nozzles and ducts will work better with a static of only 4½ in at the nozzle, than these early designs did with 8 in.

Results indicated that the suction method was entirely feasible, so it was decided that another machine would be built for the 1944 season, with such changes as experience indicated were necessary.

This next machine was built upon an old automobile chassis in which an extra transmission was installed so that ground speeds of less than one mile per hour were easily obtained. The fan was mounted on the rear and driven by an automobile engine through four C-section V belts. Also, we obtained a 6-in wide fan wheel instead of the original 4-in one, which increased fan capacity and efficiency a great deal.

Nozzles were mounted in front of the chassis as before, but were larger this time, being 19½ in by 2 in, and four in number. This gave an 80-in swath, the extra width beyond that necessary to clean a path ahead of the wheels being offset to the left side, so this side could be operated next to the trees. Connections from the nozzles were 7-in diameter round flexible rubber hoses. These were connected by pairs into wys to 10-in diameter round ducts, which were in turn wyed into the main duct leading to the fan suction. This main duct was equal in cross-sectional area to the two 10-in rounds, so constant velocity was maintained throughout the system. Particular care was taken in the design to keep the machine as low as possible in order to get in under the filbert

This is a paper presented at a meeting of the Pacific Coast Section of the American Society of Agricultural Engineers at Davis, Calif., January, 1945.

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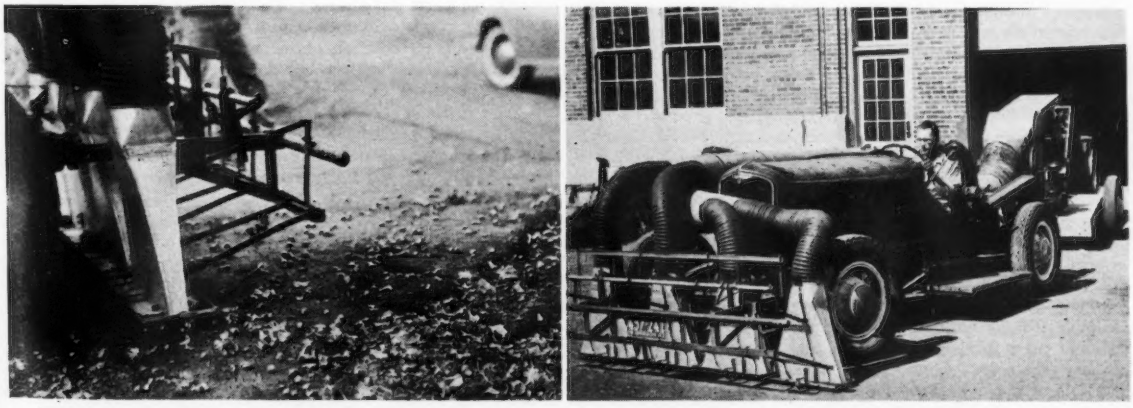

Two views of the 1944 model mechanical filbert nut picker developed by Oregon agricultural engineers

trees. Limb lifters made of pipe were installed on the left side to slide the low limbs up over the nozzles and hood and driver's head. The maximum height on the machine, at the top of the fan housing, was 54 in above the ground.

Separation of the nuts on this machine was by means of a revolving-grid unit similar to one developed by W. P. Stokes of Forest Grove, Oregon, in a small unit with which he had been experimenting. This separator was installed on a trailer, working on the discharge side of the fan and connected to it by means of a piece of 15-in flexible hose. The nuts were put through the Rembert fan as before. The separator removed the nuts from the air stream and dropped them into a hopper from which they were elevated by a chain drag conveyor to a sacking chute. The leaves passed on through the separator with the air, and we had expected that the loose nut husks would do likewise. However, these husks are much heavier than leaves, and practically all of them were caught with the nuts and consequently went into the sacks. Because of close clearance at one or more points, some nuts were cracked in the separator. Drive for the separator and conveyor was from a small air-cooled engine on the trailer.

This machine was field-tested much more extensively than the previous one. Construction on the car chassis with springs permitted travel over the highway at normal speeds, so we could get around to different areas quickly and easily. We conducted trials in many different orchards in the Willamette Valley from Springfield in Lane County to Hillsboro in Washington County, and practically all counties in between. Altogether, the machine travelled about 500 miles to and from the different areas.

The results of these trials brought much interesting information to light. Soil conditions varied so widely that no two orchards were alike. Moisture conditions also varied extensively from a dry dusty condition to operation in a pouring rain. Incidentally, the results in the rain were better than some in the dry loose soils.

We have decided that it will be necessary to have the nozzle height off the ground, as controlled by the glider shoe, adjustable. This has already been taken care of with a wide adjustable shoe located entirely behind the nozzle instead of underneath. Another factor which causes trouble is a heavy wet layer of leaves on top of the nuts. This large volume of packed wet leaves tends to choke up the nozzles frequently. We are going to try rebuilding the nozzles so that the rear skirt is about ½ to ¾ in lower than the front side, thereby permitting the front to be a little higher off the ground without losing the lifting action. We have not had an opportunity to try this out in the orchard, but tests with nuts and leaves on sod indicate much better results.

After a rain, a large percentage of the nuts are found to be cemented to the ground tightly enough to resist very effectively the suction lift of the nozzles. This can be taken care of by having a light brush or rake unit dragged ahead which will roll the nuts loose. This brush can be mounted on the nozzle-support frame so it can be lowered for use at any time, or carried up out of the way when not needed.

Wet soil, loose enough to be sucked up, constitutes the worst problem, as it cakes inside the nozzles, ducts, fan, and separator, until the whole machine chokes up. In one instance it loaded up completely in about 50 ft of ground travel. Many times we dug about 200 lb of mud out of the suction ducts. Most of this trouble was due to the soil being loose and cloddy before the rain. Proper preparation by dragging and rolling previous to harvest will eliminate most of this trouble. If the ground is smooth and hard, little trouble is experienced, as witness the fact that one of our best operations was in a heavy rain on well-prepared ground. A spray of wet mud and water blew out the discharge, but the machine did not choke up. In sandy soils, the amount of moisture with which we can successfully operate is naturally higher than with the more sticky soil types. Wetness is definitely a limiting factor; likewise, so is a very loose dry condition.

The separation unit behind the fan was a disappointment. The original, as built by Mr. Stokes, was used ahead of the fan, and our experience indicates that that is where it belongs. Also, a minimum length of suction duct between nozzles and separator is desirable. Taking the nuts out ahead of the fan will also eliminate the need for a Rembert type of fan, and permit the use of a more efficient type.

Tests of the unit showed we were using from 25 to 30 hp to handle 6500 cu ft of air with a static suction at the fan of 5½ in of water. This is a lot of power for that much performance. The air velocity in the nozzle opening figures out to be exactly 100 feet per second, which we think is a good figure for use in future designs.

Our next project will be to try to design the separator in ahead of the fan; and then, if possible, get a more efficient fan. Removing the perforated disk on the present fan will help some.

Gordon Goodpasture, of Leaburg, Oregon, became interested in a machine during the summer of 1944 and decided to build one without waiting for the results of our experimental work. The machine he constructed was built very similar to our own, using the same type and size of fan, but with the Stoke's separator ahead of the fan, and with the shield removed from the fan wheel. This machine worked quite well, using less power than ours needed. He harvested almost all of a crop of 74,000 lb of nuts with it that season, under some very unfavorable weather conditions. He is quite well satisfied with the machine, and with minor changes and improvements intends to continue using it in the future.

Due to the fact that most filbert trees branch out low down, it is almost impossible to get our fixed-nozzle machine close enough to the trees to clean up all the area. A strip from one to three feet wide on either side of the tree row usually will be left. To us, it seems that the most practical way to pick up this strip is with smaller hand-operated nozzles. This could be managed in either of two ways. One would be to have one hand nozzle operated by a man behind the machine, who would clean this strip to the center of the tree row while the machine travelled through. The other way would be to leave the strips and pick them in a separate operation. Two or four hand nozzles could be used in this case, operated on both sides while the machine travelled down the center.

For hilly orchards steep enough to require cultivation with a track-laying tractor, it is unlikely that any wheeled picking machine could be used. In this case a satisfactory solution might be the mounting of a smaller fan, separating, husking and sacking unit on the track-laying tractor, operating from the power take-off. This unit could have capacity for four hand nozzles, two to work ahead and one either side of the tractor, thus picking the whole area between tree rows in one operation. Such a unit could also be mounted on a wheeled tractor and used on level ground, and would be an economical and practical unit for small acreages. We hope to get such a unit designed and constructed before the 1945 harvest season.

The capacity of our machine with the 80-in swath travelling at 1½ miles per hour, theoretically, would be almost 1¼ acres per hour. Actually, of course, this will not be attained. Coverage of one-half to one acre per hour would probably be closer. We did not operate long enough at any one time to get any data on acreage capacity. Mr. Goodpasture's operations were so hampered by weather conditions and the resulting necessity for frequent stops to clean out the machine that he did not get any accurate data either. His total area picked was 75 acres, which we think is about the seasonal capacity for one machine of this size. Under favorable conditions it probably could cover 100 acres per season. Fuel consumption ran about 2½ gal of gasoline per hour.

To summarize briefly, the successful harvesting of filberts by the suction method depends on the following conditions, all of which we think can be successfully provided:

1 Proper preparation of the ground before harvest by use of suitable drags and rollers.

2 Picking up of the nuts, leaves and husks by means of the nozzles which are already quite satisfactory; nuts stuck to the ground to be rolled loose with a brush.

3 Separation of nuts, loose husks, and nuts still stuck in the husk, before they get to the fan. The leaves and dirt are to go on through the fan.

4 Putting the separated mass (loose nuts, nuts in the husk, and loose husks) through a husker. This is a simple compact unit which removes the nuts still stuck in the husk and at the same time breaks up any clods the size of a nut which may have been caught.

5 Removing the husks from the nuts. This can be done by a suction connection to the fan.

6 Sacking clean nuts after the husks have been removed. When the above factors have been properly accomplished, we should have a completely successful machine. *(Continued on page 155)*

# Obtaining Soil Cores for Permeability Tests

By W. E. Goode and J. E. Christiansen
MEMBER A.S.A.E.

IN SOME irrigated areas where the water is obtained wholly or in part by pumping from wells to the extent that the water table is being lowered year by year, this recession of the water level presents an increasingly serious situation. The installation of heavier pumping equipment increases capital investment, operation, and maintenance costs; and, under present conditions, it is not difficult to foresee the possibility that at some not too far-distant date these costs will have increased to the point that many now profitable farms will be forced out of production.

One remedial measure is the spreading of surplus water during periods of high stream flow on non-agricultural lands for the purpose of supplementing the available underground water and raising the water table. This has been practiced to a limited extent in southern California[2*].

Preliminary field studies in the North Kern Water Storage District in the San Joaquin Valley (H. L. Haehl, unpublished data, 1943) on some 20 tracts ranging in size from 0.01 to 57.9 acres and extending over periods up to 6 years, indicated that the infiltration rates dropped rapidly to very low values after the first 2 or 3 weeks of submergence and at lesser rates of decline continuously thereafter. To determine the feasibility of artificially spreading surplus water in that area, and to ascertain the causes of the decreases in infiltration rates which had been observed, a joint study was undertaken by several federal and state agencies[†]. As part of this study a number of undisturbed soil cores were to be obtained from the field for permeability tests under prolonged submergence. For this study, it appeared advisable to use rather large cores, and the taking of these cores for such tests presented many problems. Some investigators[1, 4, 5, 6] have taken small cores, 6 to 9 in in length, but no reference was found to any attempt to take cores 3 ft long for permeability tests. Therefore, it became necessary to work out effective methods for doing this.

The first cores were obtained in steel pipes approximately 5 in inside diameter and 40 in long. Later transparent "lucite" cylinders 4½ in inside diameter were used. Preliminary tests indicated that tight-fitting cores could not be obtained in the steel pipe without excessive compression of the soil. Some clearance between the soil core and the wall of the pipe was necessary in order to obtain the core, and then this space had to be sealed before the permeability tests could be made.

*Obtaining Cores in Steel Cylinders.* The first cylinders used for obtaining soil cores were made from used oil-well casing, 5-1/32 in inside diameter. The casing was cut into 40-in lengths, cleaned on the inside with a steel brush, and drilled and tapped, ¼-in N.F. thread, for manometer connections. A cutting shoe was machined to fit over the end of the casing. This shoe cut a core 4⅞ in in diameter, leaving an annular space of 5/64 in between the soil core and wall of the pipe. The steel cylinder with cutting shoe attached, showing the holes for manometer connections, is illustrated in Fig. 1.

The cores were obtained by jacking the casing into the soil and simultaneously excavating around the outside. The jacking was done against a 4x6-in crossbeam supported by two steel-screw anchors screwed into the soil to a depth of 3 to 4 ft.

The steel anchors (Fig. 2) were made from a combined harvester-thresher grain conveyer screw, 4 in inside diameter and 36 in long, cut in two and welded to a ¾-in pipe which was threaded for a distance of 18 in at the top and a nut provided for making adjustment in height. The spiral which originally was only spot-welded, was strengthened by welding it solid to the ¾-in shaft.

The anchors were installed by first making holes with a soil tube to a depth of 4 or 5 ft, and the anchor was then screwed in. In most soils, the anchors are very readily installed and withdrawn, but will withstand a pull of several thousand pounds. They have proved more satisfactory than several types of commercial anchors which have been tried.

After obtaining the cores, the surface of the soil in the core was covered with a piece of cloth and the remainder of the pipe filled with sand or soil. The lower end was trimmed off flush with the end of the pipe. Both ends were covered with wooden blocks which were wired in place. The cores were transported to Riverside in a truck, being placed on a bed of straw to reduce vibration and possible damage to the core. They were carried in a horizontal position with the manometer holes on the upper side.

*Preparation for Testing.* At the laboratory, the cores were prepared for permeability tests in the following manner: They were first placed in an inclined position and sealed as described below. They were then inverted, and soil was removed from the lower end to a depth of 2 cm. This space was then filled with 1 cm of sand, and 1 cm of fine gravel to form a filter which would permit the water passing through the core to move laterally to the center outlet tube with little resistance. A small brass-wire screen was then placed on the gravel, over which was fitted a wooden block with a rubber gasket. This joint was made watertight with two tie rods passing through the block and clamping over the opposite end of the cylinder. A ¼-in galvanized iron nipple was screwed into the outlet hole in the wooden block. The assembly was then righted and placed on the testing rack in such a manner that a constant depth of water could be maintained over the soil surface.

Several methods of sealing the space between the core and the wall of the pipe were considered. This seal should be impermeable, or nearly so, and should not affect the permeability of the core itself. Paraffin has been used for this purpose on small cores where the temperature can be adequately controlled[3, 4, 5]. An attempt to seal the large cores with paraffin did not prove successful, as it was found that the hot paraffin penetrated the soil very readily. Preliminary tests using a semifluid mud appeared promising. The soil chosen for this purpose was a clay containing an appreciable amount of exchangeable sodium. This mud was nearly impermeable to water movement. The seal was placed by injecting the mud through the manometers with a modified grease gun. The core was held in an inclined position and the mud was injected first in the lower hole. The injection was

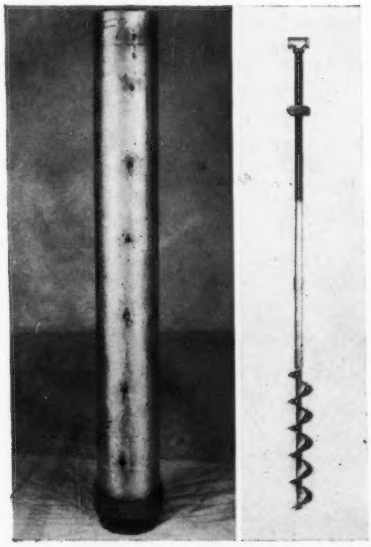

Fig. 1 (Left) Forty-inch steel cylinder with cutting shoe attached, showing holes for manometer connections. Upper two holes 4 in apart; others 6 in • Fig. 2 (Right) One of the steel-screw anchors

This paper was prepared expressly for AGRICULTURAL ENGINEERING. A contribution from the U. S. Regional Salinity Laboratory (BPISAE, ARA) Riverside, Calif., in cooperation with the eleven western states and the Territory of Hawaii.

W. E. GOODE and J. E. CHRISTIANSEN are associate irrigation and drainage engineer and irrigation and drainage engineer, respectively, Regional Salinity Laboratory, U. S. Department of Agriculture.

AUTHORS' ACKNOWLEDGMENTS: The field cores taken for this investigation were obtained with the assistance furnished by the North Kern Water Storage District, The Arwin-Edison Water Storage District, and the U. S. Bureau of Reclamation. Credit for much of the mechanical work of construction of the equipment goes to John Fletcher, and for photography to Dewey C. Moore.

†Agencies participating in this study are : U. S. Bureau of Reclamation; Division of Irrigation, Soil Conservation Service; California Division of Water Resources; North Kern and Arvin-Edison Water Storage Districts; Rubidoux Laboratory and Regional Salinity Laboratory, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture.

*Superscript numbers refer to the bibliography at end of paper.

continued in each hole until it appeared in the next higher hole. This mud seal was quite satisfactory for some of the cores, but for others there appeared to be leakage along the wall of the pipe as indicated by the manometer behavior. This method of sealing was therefore discarded and the remainder of the cores taken in the steel cylinders were sealed with a dry soil.

In later tests a slightly larger casing approximately 5-3/16 in inside diameter was used. The cutting shoe diameter was 4-13/16 in, leaving an annular space 3/16 in wide. This space was filled in the field as soon as the cylinder had been sunk to the desired depth. A sieved soil (40 mesh) of low permeability was used. It was worked down around the sides of the core with a 1/16x½-in spring-steel tamper. The core was held in the approximate center of the pipe with three spacers which were withdrawn slowly as the space was filled. Some soil was scraped from the sides of the core during the process, and there was no way to determine just how much the core was disturbed. Furthermore, there was always doubt as to the actual effective diameter of the core, because some water could pass through the seal. Whether or not the space was completely filled was difficult to determine. In spite of these objections, all of the cores sealed in this manner appeared satisfactory from the standpoint of manometer behavior during the prolonged tests.

*Obtaining Soil Cores in Lucite Cylinders.* Two of the chief disadvantages of the steel cylinder were the necessity for sealing and the inability to observe the condition of the cores. Griffith[3] reported success in obtaining tight-fitting, short cores of loam soils in smooth-wall cylinders, which eliminated the difficulties associated with sealing. Brass cylinders 3½ in in diameter and 16 in long were tried and proved satisfactory in so far as the soil compression and elimination of sealing were concerned. Glass tubing was considered unsuitable because of its fragility and the difficulties of machining and drilling for manometer connections. It was believed that transparent plastic tubes would obviate all these difficulties. Some transparent lucite cylinders, 4½ in inside diameter with ⅛-in wall thickness, were obtained and cut into 16-in lengths. At each manometer location the wall of the cylinder was doubled by cementing on a "button", 1⅛ in square, of the same material. The cylinders were then drilled and tapped, ¼-in N.F. thread, for the manometer connections. These holes were filled with short brass screws to provide a smooth inside surface while obtaining the core.

A cutting shoe was machined to fit over the end of the lucite cylinder to cut a core of approximately the same diameter as the cylinder, a slight clearance being allowed. Preliminary tests indicated that this clearance was sufficient to allow the core to move freely through the cylinder with little or no compression of the soil, but that when wetted the soil would swell sufficiently to provide a complete seal.

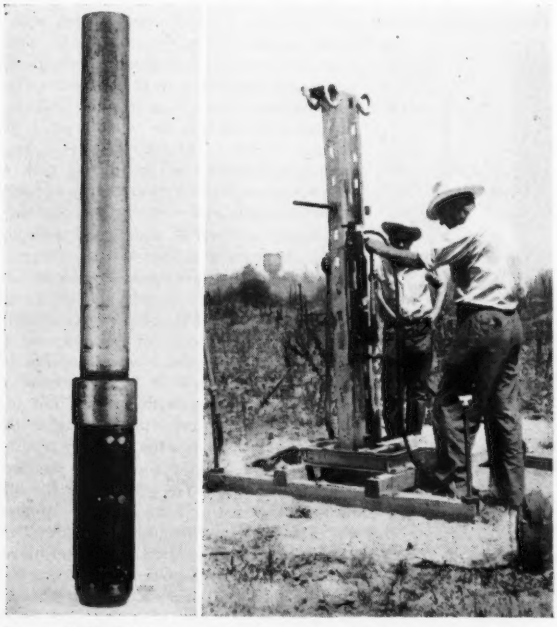

Fig. 4 (Left) Guide stem and split jacket containing cylinder with cutting shoe attached • Fig. 5 (Right) Obtaining soil core in lucite cylinder with core machine

Fig. 3 From left to right, 16-in lucite cylinder, rubber liner, cutting shoe, steel jacket, core prepared for transportation, and core prepared for testing

A steel jacket was made from a piece of standard 5-in pipe of the proper length, threaded on one end. This jacket was split down one side. Across this split a jackscrew was placed at the center of the length to spread the pipe for inserting the lucite cylinder. Two clamp screws were provided, one at each end, for clamping the jacket tightly around the lucite cylinder. A liner was cut from a sheet of rubber-gasket material, ⅛ in thick, with holes for the reinforcing buttons. This liner wraps around the lucite cylinder before it is inserted in the steel jacket and provides a cushioned grip on the cylinder, and protects it from possible damage. Fig. 3 shows, from left to right, the transparent lucite cylinder, the rubber liner, the cutting shoe, the steel jacket, a soil core as taken from the field, and a core prepared for permeability tests.

A guide stem was made from a 3-ft length of 4-in pipe welded into a 5-in pipe coupling which screws onto the steel jacket as shown in Fig. 4 which shows the complete assembly ready for taking a core.

A special machine was devised for holding this assembly in a vertical position while jacking it into the soil. This machine was improvised from a piece of equipment previously used for a different purpose. It consists of a tower made from two 4x1½-in steel channels 7 ft long mounted on a base and provided with heavy steel rings at the top. This machine is shown in Fig. 5. The stem and jacket assembly fits into the space between the vertical channels and is held by two guides which slide in the channels. The tower is bolted to a frame made from 4x6-in timbers, 6 ft long, which are anchored to the soil with 4 steel-screw anchors of the type previously described. The top of the tower is anchored to the frame with 4 chains with turnbuckles so that it can be accurately plumbed and held rigidly while the core is obtained. As the jacket assembly is forced into the ground with a hydraulic jack, soil is excavated from around the outside. For most soils, the jacking pressure is very low and the anchor chains are not always used.

Before the core is taken, two leveled stakes are driven on opposite sides of, and in line with, the center of the core site. A straightedge is laid across these stakes and the distance to the soil surface at the core center is carefully measured. Before the core is removed from the soil, the stem is unscrewed and removed and the distance to the soil surface is again measured in order to determine the compression of the soil. All of the compression, as determined in this manner, is not confined to the core as some of it occurs in the soil below the cutting shoe. In most instances, the total measured compression for the 16-in cores was less than 2 cm.

The jacket and cylinder containing the core is then removed from the hole that has been excavated around it, being careful to prevent the core from slipping from the cylinder. The jacket is spread and lifted off the cylinder and the core examined for defects. A core with cutting shoe still attached is shown in Fig. 6. If considered satisfactory, the surface of the soil is covered with a cloth and the remaining space in the cylinder filled with sand or soil. The upper end of the cylinder is then covered with a recessed wooden block and the core is inverted so that the cutting shoe can be removed. The lower end is then trimmed flush with the end of the cylinder and covered with another recessed block. The end blocks are then wired in place and the core again inverted to its original position. It is carried upright in a box on a bed of straw or excelsior to minimize vibration.

At the laboratory, the cores are prepared for permeability tests in much the same manner as the cores in steel cylinders, except that the soil is removed from the lower end to a depth of only 1.6 cm instead of 2 cm. The wooden block at the bottom is fitted with an outlet tube forming a trap with an air vent at the top and a side outlet for an extra manometer so that the over-all head loss can be more accurately determined. The lucite cylinder and core with the outlet trap and the two lower manometers connected is shown in Fig. 7.

After a number of cores had been taken and tested in the 16-in cylinders the question arose as to the practicability of taking cores comparable in length with those previously taken in the steel cylinders. Some 36-in lucite cylinders were prepared, and a steel jacket similar in design to that for the 16-in cylinders was constructed. Two cores were taken in a hard, dry Hesperia sandy loam with very little measurable compression and with only such difficulties as were due to the extreme dryness of the soil. Experience indicates that a soil which is moist, but not too wet, is easiest to sample. The core illustrated in Fig. 6 shows some shear at points around the circumference, which would have been less had the soil been slightly drier. It is impossible to avoid completely these shear fractures in some soils (which holds true as regards both metal and plastic cylinders). However, after five days submergence the shear fractures in the core in question had closed up, as was the case with a number of other cores. In other soils the fractures did not completely close. Some difficulties have been experienced in gravelly soils. These difficulties are experienced with both metal and plastic cylinders and arise more from the cuttting shoe than from the type of cylinder used.

## SUMMARY AND CONCLUSIONS

Methods and equipment for obtaining large undisturbed soil cores for permeability tests have been devised and more than 50 cores have been obtained and tested. Sealing the space between the core and wall of the cylinder with dry, sieved soil has proved satisfactory. The use of transparent plastic cylinders has made it possible to obtain tight-fitting cores which eliminate the necessity for sealing. In taking cores in the field in metal cylinders the conclusion that a good core has been obtained is based on circumstantial evidence. By using the transparent plastic cylinders the condition of the core is evident as soon as the jacket is removed, and if defective, it can be discarded at once and another core taken. In the laboratory the rate of saturation of cores in transparent cylinders can be seen and controlled, and during the permeability test the retention or absorption of air, any structural changes, any "blowing out" or channeling around manometer openings, or other phenomena taking place may be observed and recorded.

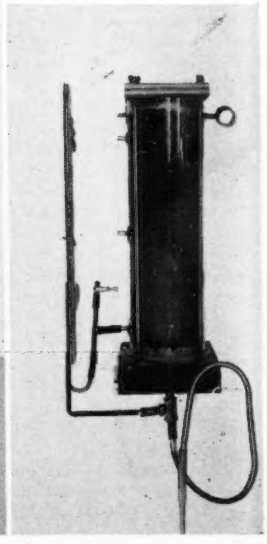

Fig. 6 (Left) Core in lucite cylinder as taken from the field. Cutting shoe still attached • Fig. 7 (Below) Side view of lucite cylinder and core ready for test. Upper manometers removed for clarity. Water supply inlet tube at upper right


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## Postwar Structures Situation

*(Continued from page 150)*

all types of farm buildings. The Institute recognizes the responsibility of the building material industry to the farmer. It encourages cooperative effort among material producers, also between private industry and public service groups in the farm structures field. It has already initiated several general movements which undoubtedly will work to improve the general condition of farm buildings.

One of the results of the activities of the Farm Structures Institute has been the organization of a group of sixteen midwest colleges for the purpose of more thorough study and more positive action on farm building problems. This group has under consideration now the preparation of a federal bill for farm structures research which, if put into effect, will advance the cause of farm structures immeasurably. Probably similar state groups will be organized in different sections of the country.

Research in basic functional requirements of farm buildings is fundamental to farm building advancement; but it is going to take a long time before such research bears results, and we cannot count upon it to help us immediately in the solution of postwar building problems.

The postwar farm building situation appears to me to be about as follows:

1 A tremendous need will exist for the rehabilitation and modernization of old and for construction of new farm buildings.

2 Little attention is being given to designing buildings to meet modern farming demands. A few examples may be cited of improved design, but agriculture in general will continue to suffer from a lack of properly designed buildings.

3 The standard types of building material are likely to be in short supply for a considerable period, and the necessity for using new and untried materials may result in a great waste of time, effort and money.

4 Construction in the farm field will also likely be hampered by a shortage of skilled building labor, which in turn will seriously hamper efficient postwar production.

The situation appears to me to be rather bad; it is serious and may have serious consequences. As agricultural engineers we should view it with apprehension and with determination to give it our best thought and attention. Prompt and radical action is necessary if the situation is to be materially improved.

## Mechanical Nut Picker

*(Continued from page 152)*

We tried our machine on walnuts, which were picked up very well, but the long-stemmed, ropy wet leaves wrapped around everything that rotated, and fouled up the separator and elevating conveyor. In Oregon where the walnuts are left on the trees until they drop out of the hulls, and possibly one-half the leaves are also down—both phenomena dependent on a hard rain to cause them to happen — we have some conditions that are going to be very hard to overcome. We do not anticipate outstanding success for the suction method of harvesting as applied to walnuts under these conditions. For other Pacific Coast walnut areas where the soil is very dry and loose at harvest time, so much of this soil will be sucked up and blown around that this method does not appear to be very promising there either.

# Factors that Affect Surface Sealing and Infiltration of Exposed Soil Surfaces

By W. D. Ellison and C. S. Slater
MEMBER A.S.A.E.

THE seal that usually forms on exposed soil surfaces during rainstorms consists of a thin layer of compacted soil which is less permeable to water than the material immediately beneath it. Wollny[1]*, in 1877, recognized that raindrops beating on the surface of the soil may reduce its permeability. Numerous investigators have since reported on various phases of this problem, Lowdermilk[2] Borst and Woodburn[3], and Laws[4]. Duley and Kelly[5] photographed such a layer and concluded it was a key factor affecting infiltration. Bennett[6] found that surface sealing is associated with sheet erosion and is variable for different soils. Ellison[7] reported that the primary cause of sheet erosion is raindrop impact and the associated splash, and that the breaking down of aggregates and muddying of surface water in the sheet erosion process causes a partial closing of pores in the surface soils which form the seal.

Surface sealing studies, reported in this paper, are based on experiments where variable raindrop impact was applied to soil surfaces. Infiltration was measured and the soil carried by splash was computed. This investigation was made to test these assumptions: It was thought that the permeability of the soil surface seal formed during rainfall may be governed by (a) the severity of mixing and puddling of surface soils by raindrop impact and (b) the specific physical properties of the soil so puddled. It was assumed that (a) the severity of the puddling and resulting permeability of the surface seal would be proportional to the quantity of soil carried by the raindrop splash and (b) the soil differences which would affect permeability of the seal could be shown by mechanical and aggregate analysis.

TABLE 1. MECHANICAL ANALYSIS OF SOILS*

| Soil No. | 2 to 0.05 mm | 0.05 to 0.005 mm | 0.005 to 0.002 mm | Less than 0.002 mm |
|---|---|---|---|---|
| I | 27.3 | 48.8 | 9.7 | 14.2 |
| II | 18.6 | 57.4 | 12.5 | 11.5 |
| III | 19.8 | 55.7 | 12.3 | 12.2 |
| IV | 29.3 | 54.4 | 10.3 | 6.0 |

*Analysis by R. L. Burling and F. R. Dreibelbis

TABLE 2. AGGREGATE ANALYSIS OF SOILS*

| Soil No. | Larger than 2 mm, % | 2 to 1 mm, % | 1 to 0.5 mm, % | 0.5 to 0.25 mm, % | 0.25 to 0.105 mm, % | Less than 0.105, % |
|---|---|---|---|---|---|---|
| I | 7.3 | 8.0 | 7.9 | 8.0 | 13.1 | 55.7 |
| II | 1.1 | 17.9 | 20.5 | 13.9 | 13.5 | 33.1 |
| III | 23.7 | 19.5 | 16.0 | 11.2 | 10.0 | 19.6 |
| IV | 14.6 | 16.2 | 18.8 | 16.4 | 14.5 | 19.5 |

*Analysis by R. L. Burling and F. R. Dreibelbis.

*Experiments and Experimental Data.* The details of the equipment and plots used as well as experimental techniques were reported in other papers[7, 8, 9].

Four soils were used in this study and the ranges in their textural and aggregate compositions are shown by the analyses given in Tables 1 and 2.

The results of infiltration tests shown in Table 3 are for the four soils listed in Tables 1 and 2. These data include observations for several different periods of artificial rainfall duration on each of the four soils, while using different sizes and velocities of raindrops and different intensities of rainfall.

The amount of soil carried by raindrop splash (denoted in Table 3 by $E$) was determined by the splash erosion formula[7] which is $E=KV^{4.33}d^{1.07}I^{0.85}$, where $K$ is a constant, $V$=velocity of raindrops in feet per second, $d$=diameter of drops in millimeters, and $I$=rainfall intensity in inches per hour. This formula was developed experimentally using eroded Muskingum silt loam which was similar to soils I and II. To determine if the formula would apply to soil IV, three splash tests were later made on this soil and the results were of the same magnitude as indicated by the formula. Although these three tests can not be accepted as conclusive evidence that the formula will apply with a high degree of accuracy to all conditions of rainfall on the four soils for which infiltration has been measured, they did show that the formula can be used for these exploratory studies.

*Effects of Rainfall Duration on Surface Sealing.* The data in Table 3 show that a small amount of surface sealing occurs on these soils without raindrop impact, when $E$ equals zero. This is shown by tests 1, 2, 22, and 26. This sealing is associated with the effects of wetting, slacking, and with adjustments of soil surface particles under the influence of surface water. The rates of such sealing are shown to be very slow and fairly uniform throughout a long time interval.

Extensive reductions in infiltration rates, as shown in tests 3, 4, 20, 21, 24, 25, and 29, were invariably associated with the larger values of $E$. Here the rates of sealing were greatest during the early part of the storm, and a large part of the sealing occurred during the first five minutes of rainfall. Since the extent of the surface sealing varies with rainfall duration as well as with raindrop impact, it is important that differences in time periods be recognized in studies of the data.

*Effects of Rainfall Splash.* The calculated values of soil splashed by raindrops were plotted against observed rates of infiltration to observe the general effect of $E$ on infiltration rates. After plotting the points for all time periods, a smooth curve was drawn for each soil type through the various groups of points. The curves were established graphically and the results are shown in Fig. 1. These results allow four inferences to be made which are summarized as follows:

1 Infiltration rates are highly sensitive to changes in $E$ (quantities of soil carried by the raindrop splash). Low infiltration rates are associated with high values of $E$.

TABLE 3. SUMMARY OF INFILTRATION DATA*

| Test No. | Soil No. | Drop velocity, fps | Drop diameters, m | Rainfall intensity iph | Infiltration rate at — 5 min, iph | 15 min, iph | 30 min, iph | 1 hr, iph | Grams ($E$) of soil in splash (computed) g/30 min |
|---|---|---|---|---|---|---|---|---|---|
| 1 | II | 0 | 5.1 | 6.5 | 4.0 | 3.7 | 3.4 | 3.1 | 0 |
| 2 | II | 0 | 5.1 | 6.7 | 3.5 | 3.2 | 3.0 | 2.8 | 0 |
| 3 | II | 10.2 | 5.1 | 6.4 | 1.8 | .7 | .6 | .6 | 34.1 |
| 4 | II | 20.4 | 5.1 | 5.8 | 1.4 | .0 | .0 | | 643 |
| 5 | III | 0 | 5.1 | 6.8 | | | | 6.7 | 0 |
| 6 | III | 3.1 | 5.1 | 4.3 | | | 3.4 | 2.6 | .2 |
| 7 | III | 3.1 | 5.1 | 6.9 | 5.7 | 4.6 | 3.5 | 2.7 | .2 |
| 8 | III | 3.1 | 5.1 | 11.4 | 6.1 | 4.3 | 3.5 | 3.0 | 3 |
| 9 | III | 3.1 | 3.5 | 4.4 | | 4.2 | 3.5 | 2.7 | .1 |
| 10 | III | 3.1 | 3.5 | 6.6 | | 5.1 | 3.8 | 2.8 | .1 |
| 11 | III | 6.1 | 5.1 | 6.5 | 4.9 | 2.7 | 2.1 | 2.0 | 3.7 |
| 12 | III | 10.2 | 5.1 | 3.3 | | 1.4 | 1.0 | .8 | 22 |
| 13 | III | 10.2 | 5.1 | 4.7 | 3.2 | 1.5 | 1.1 | 1.0 | 28 |
| 14 | III | 10.2 | 5.1 | 4.7 | 3.6 | 1.5 | 1.1 | 1.0 | 28 |
| 15 | III | 10.2 | 5.1 | 6.7 | 2.0 | 1.0 | .7 | | 35 |
| 16 | III | 10.2 | 5.1 | 6.9 | 2.4 | 1.3 | 1.2 | | 36 |
| 17 | III | 10.2 | 5.1 | 12.1 | 2.1 | .8 | | | 52 |
| 18 | III | 10.2 | 3.5 | 4.7 | 3.5 | 1.5 | 1.2 | 1.0 | 19 |
| 19 | III | 10.2 | 3.5 | 6.8 | 3.4 | 1.4 | 1.3 | | 24 |
| 20 | III | 10.2 | 3.5 | 6.8 | 2.6 | 1.6 | 1.4 | 1.3 | 24 |
| 21 | III | 20.4 | 5.1 | 6.5 | .7 | .3 | | | 692 |
| 22 | IV | 0 | 5.1 | 6.6 | 6.5 | 6.4 | 6.3 | 6.1 | 0 |
| 23 | IV | 3.1 | 5.1 | 6.4 | 6.3 | 5.2 | 4.4 | 3.7 | .2 |
| 24 | IV | 10.2 | 5.1 | 6.5 | 3.6 | 2.1 | 1.8 | | 34 |
| 25 | IV | 20.4 | 5.1 | 6.5 | 1.5 | .7 | .7 | | 733 |
| 26 | I | 0 | 5.1 | 6.9 | 2.4 | 2.3 | 2.2 | 2.0 | 0 |
| 27 | I | 3.1 | 5.1 | 6.7 | 2.2 | 1.6 | 1.4 | 1 3 | .2 |
| 28 | I | 3.1 | 5.1 | 7.0 | 2.0 | 1.6 | 1.4 | 1.2 | .2 |
| 29 | I | 10.2 | 5.1 | 6.8 | 1.4 | .2 | .1 | | 36 |

*Analysis by R. L. Burling and W. D. Ellison.

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

W. D. ELLISON and C. S. SLATER are, respectively, hydraulic engineer, division of drainage and water control (research), and soil scientist, division of erosion control practices (research), Soil Conservation Service, U. S. Department of Agriculture.

*Superscript numbers refer to the bibliography at the end of paper

2 The relationships of $E$ to infiltration are different for each of the four soils tested, thus indicating that soil properties play an important role in the sealing process.

3 The infiltration capacities of these four soils, though widely different when $E$ is very small, all approach equality as they approach zero with increasing values of $E$. This indicates that the most permeable soil tested in this work (soil IV) will have but very little more infiltration capacity than the least permeable soil tested (soil I) when the bare surfaces of both are exposed to heavy rainfall impact, as the infiltration data in Table 3 show to be the case.

4 Differences in splash erosion, generally, must be accounted for before any comparison of soil permeability can be made on basis of soil characteristics.

*Effects of Soil Physical Properties.* The differences among the curves in Fig. 1 seem to be consistent with variations in soil composition. Table 4 was prepared to show trends in the effects of clay and aggregation on infiltration rates. Percentage figures for the small aggregates and clay, taken from Tables 1 and 2, were rounded off to the nearest whole number in Table 4. Infiltration rates corresponding to two different levels of $E$ are shown for comparison.

Inspection of Table 4 reveals that permeability of the surface seal, expressed in terms of infiltration rates, is very sensitive to the percentages of small aggregates and clay in the soils. For each decrease in clay content a corresponding increase in permeability at either level of $E$ may be noted. The two soils (II and III) having the same clay content have different permeabilities that reflect the effect of variations in aggregation of the two soils. Similarly, the two that have the same level of aggregation show permeability differences related to the clay content.

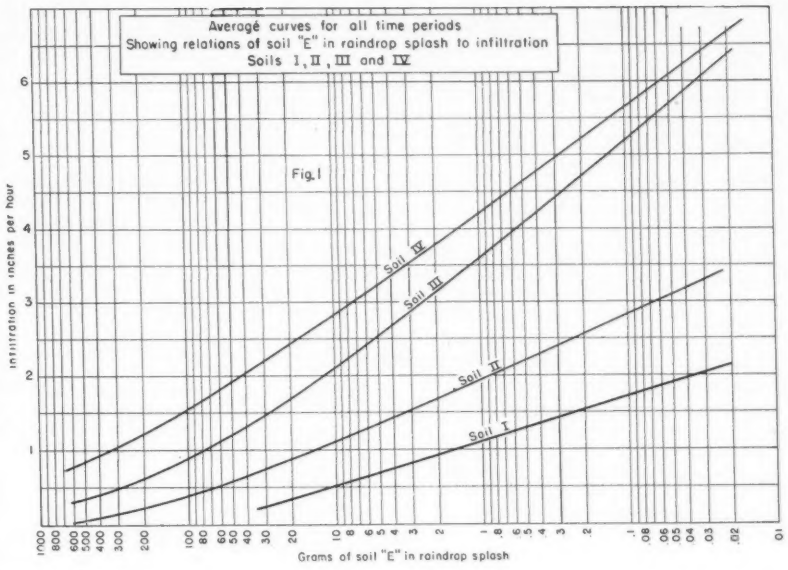
Average curves for all time periods
Showing relations of soil "E" in raindrop splash to infiltration
Soils I, II, III and IV
Fig. 1
Soil IV
Soil III
Soil II
Soil I
Infiltration in inches per hour
Grams of soil "E" in raindrop splash

TABLE 4. COMPARISON OF PHYSICAL PROPERTIES AND INFILTRATION RATES

| Soil No. | Aggregates less than 0.105 mm, per cent | Clay, per cent | Infiltration for $E=0.1$*, in/hr† | Infiltration for $E=35$*, in/hr† |
|---|---|---|---|---|
| I | 56 | 14 | 1.7 | 0.2 |
| II | 33 | 12 | 2.8 | 0.7 |
| III | 20 | 12 | 5.2 | 1.4 |
| IV | 20 | 6 | 5.7 | 2.1 |

*The amount of soil splashed is a function of time and the values of $E$ in this table are based on average 30-min time intervals.

†The infiltration rates are averages for all time intervals shown in Table 3; this average is 25 to 30 min for each test.

It is expected that increased quantities of dispersed clay particles would decrease the permeability of the seal that is developed. However, the mere presence of large amounts of clay in any one of these soils does not insure a highly impervious surface seal. Slater[10] states "The permeability of (a soil) . . . . would necessarily vary widely, depending on the extent to which its structure could be maintained, as all clay soils are potentially impermeable; that is, they are impermeable or only slightly permeable in a puddled or compacted condition." Some of the aggregates must be broken down in order for the clay to be most effective in the sealing process. The fineness of the aggregates would be an indirect measure of the amount of clay dispersed in any specific soil, but because the clay content varies from one soil to another, it was thought necessary to use both factors, the fineness of the aggregation and the clay content, for comparing results from different soils.

There are some indications that the percentage of large aggregates of more than 1.0 mm may play an important role in the infiltration process when $E$ is very small. This is indicated in Fig. 1 where the curves for soils III and IV converge for lower values of $E$. Soil III has 43.2 per cent of aggregates greater than 1.0 mm and soil IV has only 30.8 per cent of these larger aggregates (see Table 2). Very probably these large aggregates are not broken down by a small amount of impact and the clay particles remain bound in the aggregates. Under these conditions the infiltration rates should not deviate greatly from the normal percolation capacity of the soil.

It can be inferred that the four variables (a) duration of rainfall, (b) soil carried by the raindrop splash, (c) aggregation, and (d) clay content of the soil, are the principal factors which affect infiltration rates on these soils. Other properties of the soil may have an effect on surface sealing; however, their effects were not outstanding in these tests. The four soils used in these studies were too similar to bring out the effects of all different soil properties which may possibly have some influence on surface sealing, but clay content and small aggregates were found to have so marked an effect that it seems evident they must play an important role in all surface sealing.

## CONCLUSIONS

Surface sealing represents a major field problem. It influences the factors of runoff, soil moisture, and ground water. Although the data at hand were not adequate to serve as a basis for evaluating the effects of each of the separate factors studied, they do show some promise that a new attack can be made on the problem of infiltration through measuring the amount of soil splashed by raindrops and determining its physical properties.

Attempts to evaluate field infiltration by separate studies of rainfall rates, drop sizes, drop velocities, soil characteristics, canopies and surface conditions become almost hopelessly complex. This is due in large part to the natural variability in most of these factors during a rainstorm which prevents treating these variables as temporary constants for a storm period. A single rainstorm, for example, may have several periods of markedly different intensities, drop sizes and drop velocities. Soil surface conditions may also undergo wide change during the period of rainfall, and even the effects of cover may vary with changes in storm characteristics. The studies covered by this report indicate the probability that rates and amounts of soil splashed by the raindrops, and represented by $E$, may be so closely related to the total effects of all these separate factors on soil permeability that further studies of soil splash will offer a means of simplifying the collection and interpretation of field data, so that the problem of infiltration can be attacked in a more practical manner.

In the further development of the splash studies the effects of time on soil splash must be obtained. It may be possible to include a factor of time in the splash erosion formula. The equation would then read $E=KV^aD^bI^cf(t)$. A number of experiments will be required to evaluate function $t$, but this development will be necessary before precise values on $E$ can be determined for different time intervals.

It has been shown[7] that the aggregates are broken down into smaller fragments under raindrop impact than they are by the wet sieve method of determination. Since this is so, it may be desirable in extended studies of field soils to give *(Continued on page 162)*

# Do I Want Ag Engineering?

(EDITOR'S NOTE: The above title sums up the questions asked by a private in the AAF in a letter to the engineering department of a well-known farm equipment manufacturer. His letter, under the subtitle "Inquiry", follows—together with what the chief engineer of the company, an A.S.A.E. member, told him, under the subtitle "Reply.")

INQUIRY:

TO ASSIST me in a vital decision regarding my postwar career, I need certain information about agricultural engineering and its possibilities for my future. Will you please give me as much of this information as is readily available concerning agricultural engineering in relation to your products for farm use:

1 Are the men who "engineer" your production of farm equipmen college trained, or are they trained by practical experience in industry and agriculture? If college trained, what colleges and what courses are favored? What proportion of your engineers are graduate agricultural engineers?

2 Are your agricultural engineers concerned with research for improving your products and designing or inventing new ones, or are they as likely to be confined to slide rules and log tables as other engineers? Do they work with tools or with pencils, in overalls or in white collars?

3 Approximately how much pay do your agricultural engineers receive? How does their pay compare with that of other engineers, journeyman toolmakers, setup men, supervisors, etc., for example?

4 It is said that the most important tool of the engineer is the ability to apply mathematics. I don't care much for math, but I love machinery, especially farm machinery. Perhaps agricultural engineering is not exactly what I want; is there a job or position which is a combination of mechanic, inventor, technician, and "monkey-wrench engineer"?

I deeply appreciate your cooperation and assistance in this matter which is of great importance to me. I hope that after the war I will in some way be able to return the consideration.

REPLY:

Agricultural engineering is a rather large field. For the sake of this letter, I shall confine myself to that division which concerns itself with the development and design of farm equipment, more specifically yet with design of farm implements.

Your first three questions do somewhat oversimplify the situation. Some of the men who engineer farm implement production are college trained; the number has steadily increased over the last twenty years and will keep on doing so. College training provides a few convenient tools to the engineer. Slide rules and log tables are some of them; but there are others of greater importance, such as strength of materials, dynamics, kinematics. As a rule, the successful engineer will have a good basic training and a good deal of practical experience. For a man who wants to develop farm equipment, experience in industry and in agriculture are, of course, prerequisites. Until a certain amount of practical experience is acquired, and the ability to apply training and experience is proved, pay is apt to be small, no worse though than in other occupations.

As to what college courses are favored, for design work and related activities, I would rather put the stress on engineering than on agricultural. By this is meant that stress is placed on engineering fundamentals and the ability to apply them. A certain amount of research work on the part of the engineer generally precedes design work. Many engineers just love to put on overalls once in a while and spend some time in the field. However, it will not do to generalize. A given job can be approached in quite a few different ways.

You say you don't care much for mathematics, but you love to play with machinery, farm machinery especially. That is fine; you have an inclination; that is very necessary. But let me warn you, there is no easy way to the fulfillment of your ideals. My advice would be, make a good tool of mathematics, and the less you like it, the more force yourself to apply this tool wherever possible, if for no other reason than to convince yourself that your intuitive guesses were fairly correct.

I have a great respect for the self-taught man; finding your own way is always a little harder than ta travel under the guidance of others who have previously gone in the same direction. College training is no substitute for experience, but the knowledge it gives you is apt to widen your horizons and give you a broader view of the problems arising out of your life's work.

## New Literature

"MAN AND THE SOIL," by Karl B. Mickey. Paper, 6x9 inches, 110 pages, illustrated. International Harvester Co., Public Relations Department, 180 N. Michigan Ave., Chicago 1, Ill. A copy will be sent on request to publisher.

This book is a scholarly presentation of the subject, indicated by the title, in the language of the layman and with a minimum of scientific terminology. It is intended as a compendium of the historical, political, social, economic, and agronomic aspects of soil conservation and its antithesis, soil erosion. The book is divided into six chapters, as follows: Chapter I deals with man's kinship to the soil and establishes his fundamental relationship to and dependence on agriculture. Chapter II is devoted to both natural and man-made soil erosion. Chapter III discusses soil erosion in history, establishing the antiquity of soil depletion, reviewing the rise and fall of ancient empires, and relating their fortunes to decline in soil fertility. Chapter IV, on erosion as a social symptom, discusses the social significance of soil depletion; a number of the farmer's "economic disabilities" are explained and the social and economic aspects of soil depletion and preventives of its arrest are discussed. Chapter V deals with conserving the soil, and together with Chapter II, contains all the significant current thinking on the practices and principles of soil conservation. Chapter VI deals with the solution of soil conservation problems based on American principles.

"CORROSION," a 54-page publication issued by the International Nickel Co., Inc., 67 Wall St., New York 5, N.Y. Sent on request to equipment designers, engineers, or other metal users.

This publication is a convenient and comprehensive analysis of corrosion principles for both the practical man and the technician in the metal field. It has been prepared in the belief that a good working knowledge of corrosion is the best possible means of securing maximum equipment life and minimum maintenance costs in situations where this destructive process must be taken into consideration. An opening section explains how corrosion processes work, and discusses all the known factors that influence their action: acidity of solution, oxidizing agents, temperature, agitation, films, inhibitors, surface condition, stress, heat-treatment, welding, concentration cells, and galvanic action. These discussions are illustrated with graphs, drawings and tables. The detailed review of testing methods that follows tells how service conditions are simulated in corrosion research. Included is a description of the construction and use of the well-known, spool type specimem holder for determining the comparative behavior of several metals and alloys simultaneously under actual operating conditions.

The applicability of Monel, nickel, and Inconel in various corrosive media is analyzed in the closing section. Tables list nearly 500 typical corrosives in which these alloys have been successfully used.

"1944 BOOK OF A.S.T.M. STANDARDS" (in three parts). American Society for Testing Materials, 260 South Broad Street, Philadelphia 2, Pa. Price of each part, $10.00; supplements, $4.00 for each part, each year; half-leather binding, $1.00 extra for each part and each supplement part.

Issued in three parts, this book contains, in the latest approved form, all of the A.S.T.M. widely used specifications and tests for materials. This latest edition contains 1235 specifications and standard methods covering more than 6000 pages. All specifications are given, whether formal or tentative standards. The three divisions of the books are arranged as follows: *Part I. Metals* — Ferrous and non-ferrous metals (all A and B and some E serial designations) except methods of chemical analysis. General testing methods (E serial designations). *Part II. Non-metallic Materials* (Constructional)—Cementitious materials, concrete and aggregates, masonry building units, ceramics, pipe and tile, thermal insulating materials (all C serial designations). Wood and wood preservatives, paints, varnishes and lacquers, road materials, water-proofing and roofing materials, soils (certain D serial designations). General testing methods, thermometers (E serial designations). *Part III. Non-metallic Materials* (General)—Fuels, petroleum products, electrical insulating materials, rubber, textiles, soaps and detergents, paper, plastics, water (remainder of D serial designations). Each part of the 1944 book has a complete index. There are two extensive tables of contents; the first list all standards under general material headings and the second according to the material designations of the standards. To keep the books up-to-date, a supplement will be issued to each part late in 1945.

# A. S. A. E. War Service Honor Roll

LISTED here are the names of those members of the American Society of Agricultural Engineers who are, or have been, on active duty with the various war services of the United States and its United Nations allies, according to the records at A.S.A.E. headquarters. This list is kept complete and up to date in so far as possible, and the Society will welcome information from its members — and members of their families — covering (1) additions to the list, (2) promotions in rank, (3) changes or corrections as to branch of service, (4) discharges from services, etc. Such information should be reported promptly to the Secretary, A.S.A.E., St. Joseph, Michigan.

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C. L. SEAL, S 1/c, Radio technician, USN
M. R. SEATON, Capt., 44th Ren. Sqd., 11 Cav. Group, USA
C. B. SECKINGER, Capt., G-1 Section, Hq. USAFIME, Ord. Dept., USA
E. I. SHANFIELD, 2nd Lt., AAR, USA
J. L. SHEPHERD, Capt., Air Force, USA
K. W. SNYDER, Naval Officer's Training, U.S. Naval Academy
C. B. SOLTERBECK, 1st Lt., 410th Engr., Co. A, USA
J. W. SORENSON, JR., Maj., 142nd Infantry, 36th Division, USA
JACOB SOSNE, Pvt., USA (Honorable discharge)
J. P. SPIELMAN, Lt., Air Force, USA
A. J. SPRECHER, Pfc., Hq. & Hq. Sqd. 7th AFSC/POA, USA
J. P. STAFFORD, JR., Capt., Corps of Engineers, USA
H. N. STAPLETON, Capt., CAC, USA
A. H. STEPHENSON, Capt., 748th AAA Gun Bn., USA
G. H. STEWART, Capt., Hdq. 563rd Signal Co., USA
H. J. STOCKWELL, Maj., 11th Bn., 4th Regt., USA
LOWELL STODDARD, Pvt., Aircraft Mechanics Student, USA
H. E. STOVER, Maj., Coast Artillery, USA
J. W. STRATTON, Pvt., Air Corps, USA
E. L. STREB, Pvt., Infantry, USA

*(Continued on page 162)*

Originated by John Bean Mfg. Co.

# FMC HIGH-PRESSURE SYSTEM FOR FIGHTING FIRE WITH FOG

Don't confuse the results obtainable from FMC High-Pressure Fog Fire Fighting with any other system. There's nothing like it!

In fighting fire with the most efficient fog — you must have high pressure. And that's what you get with the FMC Fog Fire Fighter.

The FMC High-Pressure Pump easily delivers and maintains *800 lbs. pump pressure* — better than *600 lbs. nozzle pressure.*

## A LITTLE WATER GOES A LONG WAY

The high pressure gives you a combination of high velocity and finely-atomized water—just what you need to *blast, cool* and *smother* flame. Every droplet of water is broken up into thousands of tiny particles that can be *"blasted"* into the source of the fire.

One gallon of this finely-atomized fog, properly used, has the fire-quenching possibilities of many times that of any low-pressure water.

Investigate! FMC High-Pressure Fog is the greatest contribution ever made to fire fighting. It has proved its worth at thousands of city, rural, forest, factory and airport fires.

**FMC FOG FIRE GUN IN ACTION!** Fireman holds trigger release with his right hand and adjusts barrel with his left hand. By turning the barrel slightly, he can change the flow from a straight carrying stream to a wide fog pattern, as shown, and can get close enough to fires to do effective work.

## 600 lbs. AT THE NOZZLE!

The FMC Fog Fire Gun—built only by Bean—is designed especially for High-Pressure fire fighting.

*Note these features:*

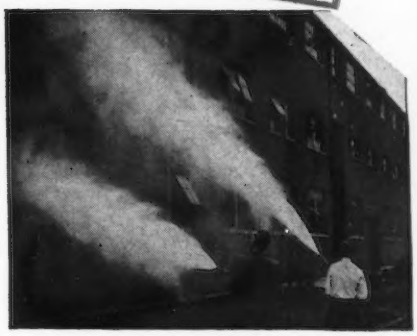
**1 PROTECTIVE SPRAY.** Special spray protects face and shoulders from heat.

**2 ADJUSTING BARREL.** By turning barrel, flow can be changed from a straight "power" stream to a close-up fog for any type of fire.

**3 TRIGGER GRIP.** Gives natural position to arm and grip, and is easy to hold. No fatigue.

**4 GUN LOCK.** Stream can be set in any pattern and locked there if desired. Relieves hand and arm muscles.

**5 HOSE SWIVEL.** Eliminates bothersome twisting of hose.



## IT'S THE PRESSURE AND THE PUMP!

**800 LBS. AT THE PUMP!** That's a pretty tough job for any unit. But — the FMC High-Pressure Pump has proved its ability to deliver and maintain that pressure at thousands of fires. The reason? This pump—built only by Bean—is different from all other pumps and is designed especially for high-pressure work by high-pressure pump engineers.

## FMC Original HIGH-PRESSURE FOG FIRE FIGHTER

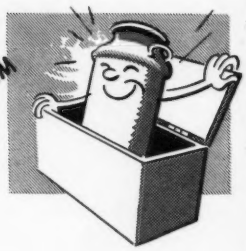
CAN BE MOUNTED ON MOST STANDARD TRUCK CHASSIS

**FOOD MACHINERY CORPORATION**

JOHN BEAN MFG. CO., 70C HAZEL ST., LANSING 4, MICH. • BEAN-CUTLER DIVISION, 400 JULIAN ST., SAN JOSE, CALIF.

BUILDERS OF BEAN HIGH-PRESSURE PUMPS FOR OVER 60 YEARS

# KEEP FARM PRODUCE COOL FOR HIGHER PROFITS

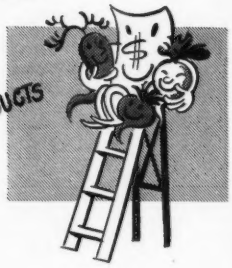


## GET HIGHER PRICES FOR CREAM

An electric milk cooler keeps bacteria count low; saves as much as $4.77 a month over mechanical cooler on a farm cooling four 10 gal. cans per day.

## COOL EGGS STAY FRESH LONGER

Helps you get top prices. Saves you trips to town. Use an electric refrigerator; blow cool, damp air over them; or build special cabinet with blower.



## TOP PRICES FOR GARDEN PRODUCTS

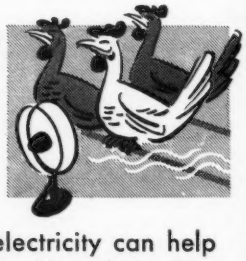
Sell them at out-of-season prices by storing surplus berries, fruits and vegetables in a farm freezer.

## ROADSIDE MARKET ADDS PROFIT

Get retail prices for produce and fresh vegetables. With a large electric refrigerator you can keep a good supply in top condition.

## COOL HENS MEAN MORE EGGS

A fan in the poultry house in summer increases egg production. Forced air circulation in dairy barn, milk house and kitchen pays a profit in summer, too.



There are many ways electricity can help increase your profits. Some, like milk coolers, water systems, motors and lighting, you can add today. Others must wait. Your local power supplier or dealer can tell you what is available. Whether you buy today or tomorrow, remember that Westinghouse quality assures dependable service. J-91700

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

TUNE IN JOHN CHARLES THOMAS, SUNDAY, 2:30, EWT, N. B. C. HEAR TED MALONE, MON. TUES. WED. EVENINGS, BLUE NETWORK.


## A. S. A. E. War Service Honor Roll

*(Continued from page 160)*

SAMUEL STREBIN, Lt.(jg), Staff Comseronspac, USNR
N. P. SWANSON, Ens., USNR
J. G. TAYLOR, T/Sgt., 110th Sig. Radar Maint. Unit, USA
H. R. TEST, Maj., Pers. Adj. Hdq., AAF, USA
W. D. TEST, Capt., Btry, C, 195th AAA Bn. (SP), USA
A. E. THEISEN, Pfc., USA
H. J. THOMPSON, Lt., 736 Eng. Heavy Shop Co., EUTC, USA
H. O. THOMPSON, Lt., 314 Airdrome Sqdn., USA
L. F. THOMPSON, Maj., 36th Field Artillery, USA
D. L. TRAPP, Pilot Officer (Navigator), RCAF
M. W. TREIMAN, 2nd Lt., Air Force, USA
J. R. TURNER, 2nd Lt., 855th Avn. Eng. Bn., USA
W. L. ULICH, 2nd Lt., Quartermaster Corps, USA
R. H. VAHRENKAMP, Capt., Inf., 8th Corps, Hdq. Southern Defense Command, USA
J. E. VEATCH, Maj., 1157th Engr. C Grp., USA
F. J. VENRICK, Spl/C (R), USNR
E. B. WAHLGREN, Lt.(jg), A-V(S), USNR
R. L. WALKER, Maj., 75th Ferrying Sqdn., 2nd Operational Training Unit, AAF, USA
H. B. WALL, 2nd Lt., 6th Cavalry, USA
J. A. WEBER, T/5, 3542nd Ord. Med. Auto. Maint. Co., USA
T. H. WEEKS, 1st Lt., CE, 357th Engr. Regt., USA
W. A. WELD, Capt., Corps of Engineers, AUS, USA
J. H. WESSMAN, 1st Lt., USA (Honorable discharge)
W. C. WHEELER, Capt., 329th Infantry, USA
E. R. WHITACRE, T/Sgt., Harbor Craft Gp., USA
L. L. WHITAKER, Lt.(jg), USNR
R. N. WHITE, Capt., Air Force, USA
D. C. WIGGINS, Ens., Civil Engineers Corps, USNR
E. B. WILLIAMSON, Pvt., 3rd Platoon, Co. C, 30th ET Bn., USA
C. D. WIMAN, Col., Ordnance Dept., USA
J. K. WINDELL, JR., Cpl., Co. M, 389th Inf. Regt., USA
J. W. WOLFE, 1st Lt., Co. G, 32nd Infantry, USA
W. S. WOODS, A/C, Sq. D2-Class 44F, USA
O. C. WORD, JR., Lt. Col., Hdq. ERTC, Gp. II, USA
J. R. W. YOUNG, Lt., Royal Canadian Navy

### GOLD STAR MEMBERS

LT. SAMUEL J. BALDWIN — January, 1943
CAPT. WILLIFORD D. BLAND, JR. — December, 1944
LT. JOHN E. COTTINGHAM — January, 1943
1ST LT. HENRY L. ESPENSEN — July, 1943
LT. JAMES E. MCCAY — January, 1943
LT. A. H. THOMPSON — January, 1944

## Factors that Affect Surface Sealing and Infiltration of Exposed Surface Soils

*(Continued from page 157)*

them a more rigorous treatment when making aggregate determinations for purposes of studying the resistance of a soil to surface sealing. Probably the soil samples to be tested for these purposes should be taken from the surface seal on a bare soil following a heavy driving rainfall.

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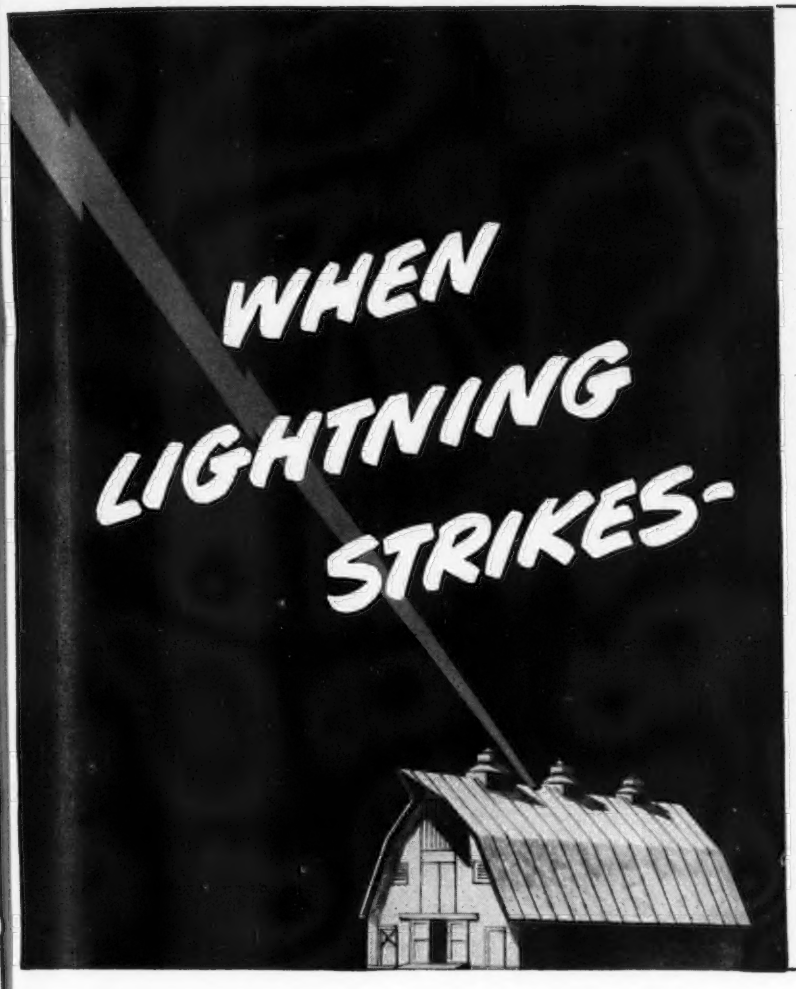


U·S·S Steel Roofing and Siding—

Protects against FIRE

Protects against RATS AND MICE

Protects against STORMS

# You can't beat *Steel* for protection

THERE'S no better shield against lightning than a properly grounded steel roof. Such roofs are not damaged by lightning, since they conduct the charge harmlessly into the ground.

But lightning protection is only one reason for recommending steel roofing and siding. Steel helps prevent fires. It keeps rats and mice from eating stored crops—and most important of all—it keeps farm buildings tight and dry.

Steel is sanitary. For chicken houses and dairy barns it can be kept clean with less labor.

For farm equipment, steel offers the most for the money. No other material does so many jobs so well.

U·S·S Steels have been famous on the farm for more than fifty years. We invite you to consult with our trained men on any problem involving steel. They can give you practical help and there is no obligation. Write any of the companies listed below for more information.

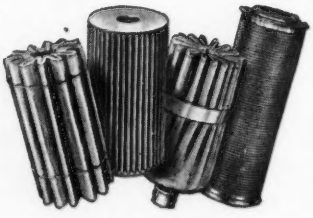
## U·S·S Steel Roofing and Siding

**CARNEGIE-ILLINOIS STEEL CORPORATION**, *Pittsburgh and Chicago*
**COLUMBIA STEEL COMPANY**, *San Francisco*
**TENNESSEE COAL, IRON & RAILROAD COMPANY**, *Birmingham*
**AMERICAN STEEL & WIRE COMPANY**, *Cleveland, Chicago and New York*
United States Steel Export Company, New York

USS STEEL UNITED STATES STEEL

UNITED STATES STEEL

This loaded filter element represents a lot of "tractor trouble" that didn't happen—thanks to Purolator's efficiency in removing harmful, motor-damaging abrasives from lubricating oil. Purolator makes all types of tractor and stationary engine oil filters and oil filter elements. In fact, Purolator makes and sells more tractor and stationary engine oil filters and filter elements than all the rest of the oil filter industry combined. We gladly offer the assistance of our staff in the solution of oil filtration problems, especially those connected with scientific agriculture. Purolator Products Inc., Newark 2, N. J., founder and leader of the oil filter industry. In Canada: Purolator Products (Canada) Ltd., Windsor, Ontario.



# NEWS SECTION

## A.S.A.E. Officers for Year 1945-46

AS A result of the regular annual election of officers of the American Society of Agricultural Engineers, conducted by letter ballot during February and March, the following have been elected and will take office at the regular meeting of the Council in June:

*President,* J. Dewey Long, chief, research department, Douglas Fir Plywood Association.

*Councilors* (3-year term each), W. J. Coultas, chief experimental engineer, John Deere Harvester Works, Deere & Co., and Henry Giese, professor of agricultural engineering, Iowa State College.

The new Council of the Society for the year 1945-46 will include the above-named officers, together with the following: A. W. Turner and R. H. Driftmier, past-presidents; and W. D. Ellison, F. C. Fenton, F. E. Price, and D. A. Milligan, councilors.

The newly elected Nominating Committee of the Society consists of E. L. Hansen (chairman), E. L. Barger, and W. D. Hemker. Members of the Society are requested to send to any member of the Committee such suggestions as they may have for nominees for elective offices of the Society in the next annual election, to be held early in 1946.

## Ag Engineers to Attack Bottlenecks

"FARMERS of Wisconsin," says F. W. Duffee, chairman, agricultural engineering department, University of Wisconsin, "tell us that the three major bottlenecks in farm labor demand are hay making, corn silage harvesting, and barn chores. Hay harvesting and corn silage making are now mechanized — at least the machinery is developed and will be available when wartime restrictions are lifted — so now we propose to attack the other major bottleneck, namely, barn chores."

The foregoing statement accompanies a news release announcing that the University of Wisconsin will conduct extensive research on the possibilities of shortening the time and reducing labor requirements through automatic electric mechanization of a great part of the work on dairy farms that is now being done by hand. This research project will get under way as soon as the wartime emergency will permit, under terms of an industrial fellowship agreement with the Wisconsin Utilities Association, recently approved by the board of regents of the University. This new project follows through on other original research conducted by the University twenty years ago which pioneered rural electrification in Wisconsin under successive fellowships established by the W.U.A.

Terms of the agreement between the University and the W.U.A. stipulate a study of "economic use of electric light, heat, and power — for the purpose of saving labor, improving the quality of milk produced, and reducing the cost of milk production. The first phase of the investigation will include time-and-cost studies of methods dairy farmers now use in doing chores. With the records thus obtained for comparison, the next step will be to erect and remodel buildings and test equipment, to determine how present methods can be improved."

## A.S.A.E. Activities in Fertilizer Application

THE activities of the American Society of Agricultural Engineers dealing with fertilizer application are in the hands of the Committee on Fertilizer Application (Power and Machinery Division). In addition to functioning as an independent committee of the Society, its members also represent the Society on the National Joint Committee on Fertilizer Application, on which is also represented the American Society of Agronomy, the American Society of Horticultural Science, the Farm Equipment Institute, and the National Fertilizer Association.

Functioning jointly with other groups represented on the National Joint Committee, the objectives of the A.S.A.E. committee are as follows:

1 To coordinate research activities pertaining to methods of fertilizer application and to the requirements of improved fertilizer distributing equipment.

2 To promote research, machinery developments, field demonstrations and other activities designed to establish farm practices in which fertilizers will be applied in the most effective manner.

3 To collect and compile current information bearing on fertilizer-placement developments. *(Continued on page 166)*

# HIGH COMPRESSION AND GASOLINE

**helped harvest 1,019,500 acres to set a new world record**

**The MASSEY-HARRIS HARVEST BRIGADE of 1944 harvested more grain with less fuel, manpower and equipment than ever before in history.**

**Early in 1944,** a giant fleet of self-propelled combines streamed out of the Massey-Harris factory. One division headed for Texas and the vast Midwest grain belt . . . others went to California and the Pacific Northwest.

Then began the battle of the grain. To fight it, Massey-Harris depended on *high compression* and *gasoline*. They chose high compression engines to get the full power out of every drop of fuel used. They chose gasoline for easy starting, quick warm-up and better idling.

In state after state the 500 Brigade operators maneuvered their combines over gullies, hills and rain-soaked fields to roll up a record of better than 2000 acres apiece. In spite of the fact that they were racing against time, they used only a fraction over ¾ gallon of fuel per acre.

The 1944 Harvest Brigade saved millions of bushels of grain for America, proving once more the efficiency and economy of high compression and gasoline. This is the same combination that in tractors is helping farmers everywhere to meet wartime production goals.

**ETHYL CORPORATION** • *Agricultural Division*

Chrysler Building, New York 17, N. Y.

**Manufacturer of antiknock fluids used by oil companies to improve gasoline**

## Fertilizer Placement Activities

*(Continued from page 164)*

As an independent committee of A.S.A.E., the Committee's objectives are as follows:

1 To organize and conduct specific research projects on the mechanical application of fertilizers.

2 To develop special fertilizer distributing machinery for use in crop experiments.

3 To aid research workers, implement manufacturers, farmers, and others in selecting, using, or designing improved fertilizer distributing machines.

4 To direct the attention of qualified investigators to basic considerations in plant food utilization and to otherwise aid in such research.

In accord with the most urgent problems and requirements arising in connection with new demands for the production of essential crops and the changes in available supplies of commercial plant food and distributing machinery under prevailing wartime conditions, the Committee's program is as follows:

1 Continue current research activities and participate in organizing and conducting other needed studies on methods of fertilizer application including the use of liquid and other new forms of fertilizer materials.

2 Aid directly and indirectly in providing suitable fertilizer distributing equipment in emergencies where standard machinery is neither adaptable nor available, as well as contributing to the improvement of the usual line of distributors and new machines to be offered to the farm trade.

3 Promote the adoption of improved methods of fertilizer application and the selection of proper equipment.

The introduction and production of new crops for essential war materials, the necessity and desirability of using ammonium nitrate and other sources of nitrogen, the different effects on the crop of the various forms of current phosphate materials, the curtailment of machinery production, the need for increased seed production, and other factors—all these present new problems for the consideration of the Committee.

Each member of the Committee is concerned with some part of the general program through his regular duties; thus individual assignments consist primarily of making the greatest possible use of every opportunity afforded for some contribution in the respective spheres of activity. Also, observations are made and information recorded for the purpose of reporting the activities, accomplishments, trends, and new problems of the current year.

*Progress.* Fertilizer placement research was expanded considerably during the 1944 season as an essential wartime activity. The number of fertilizer-placement experiments in 1944 was approximately 350 as compared to 209 in 1943 and 136 in 1942. In addition, various experiments involving the application of ammonium nitrate in different forms including liquid materials were conducted.

Fertilizer placement demonstrations were increased 50 per cent.

The development of new and improved fertilizer distributing machinery included liquid distributors, additional plow attachments, tractor-mounted deep-placement tools, arrangements for mounting small combination planters and fertilizer distributors on tractors, and plans for local construction of simple broadcasters.

Fertilizer consumption was greater and more interest in improved methods of application was evident because of the desire of more farmers to further increase crop production.

*Results.* The progressive improvement of fertilizer-application methods and equipment in recent years accounts, to an appreciable extent, for the consistently large production of farm crops during the war period.

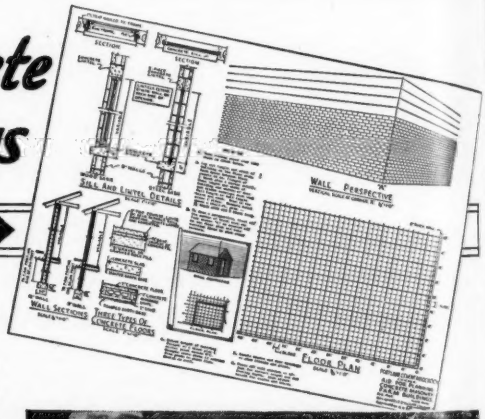
Deep placement of fertilizer at ordinary plow depth, and deeper in some instances, has proven advantageous in numerous cases and the conditions under which this method is successful have been more definitely determined.

The proper balance of all major soil and fertilizer factors including fertilizer placement has experimentally raised normally low yields in certain areas to a high level.

Analysis of plant tissues and other fundamental considerations have brought to light some of the differences in plant composition due to the placement of the fertilizer with respect to the seed or plant roots.

The combined effect of all efforts *(Continued on page 168)*


# Aid to planning Concrete Masonry Farm Buildings




**Here's a modular detail sheet which simplifies the work of designing farm buildings of concrete masonry.**

**Laid out in multiples of a 4-inch module, use of this grid sheet will save time for agricultural engineers in layout and detailing of concrete masonry dairy barns, milk houses, storage buildings, farm homes and other essential farm structures.**

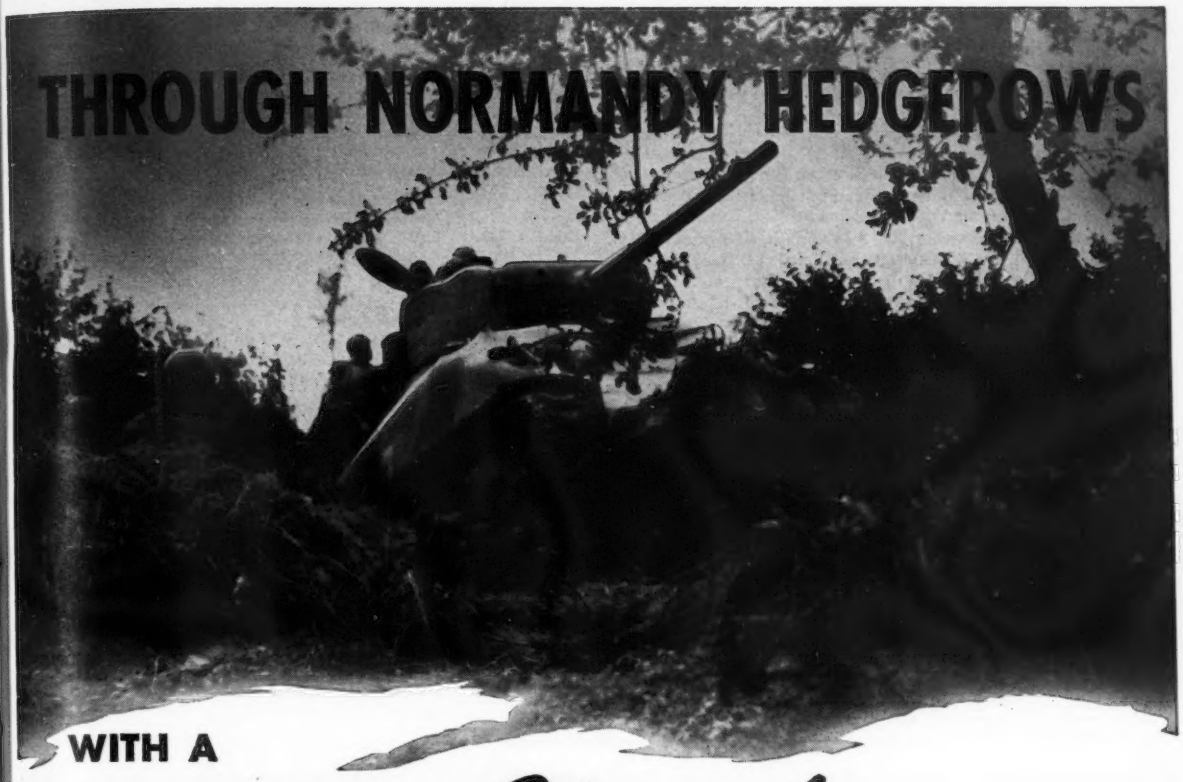
**Send for this "Aid For Planning Concrete Masonry Farm Buildings." It is free in the United States and Canada.**

**Our engineers, supported by years of scientific research and field experience, will gladly assist you to get the ultimate economy and service from concrete on any farm construction project.**

**PORTLAND CEMENT ASSOCIATION**

**Dept. A4-1, 33 W. Grand Ave., Chicago 10, Illinois**

**A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work**




WITH A

# LIPE *Clutch*

## that never cries "Quit"

The giant's teeth on the front of this tank are special equipment, put there to smash through the banked earth, stones and roots of Normandy hedgerows. But the heart of the monster—the Lipe clutch that takes the opposed thrust of the powerful engine and grinding caterpillars—is just a standard tank-type clutch, developed by Lipe for the Army Tank Corps.

From destruction in France to construction in Florida, Lipe Clutches move without a hitch. Here, in bottom-dump EUCLID trucks of the Hooper Construction Company, they move wet sand under the power of 150 hp Cummins Diesel engines.

### Engineered For the Job They Do

Lipe Clutches afford wide margins of excess capacity in any given job because they're engineered for the particular job they do. In developing a clutch for any use, Lipe engineers start with a proved basic design, plus years of practical application experience. With this as a foundation, they're equipped to build clutches that repeatedly stand up better, give more engagements between teardowns, are better suited to the structural and operating limitations of the vehicle in which they are used, and cost less in over-all maintenance and replacement. That's why 85% of the heavy truck makers in America standardize on Lipe Clutches.

**Ask for a free engineering analysis of your requirements. Just send a drawing or detailed description, or tell us you want a field engineer to call. No cost. No obligation.**

**LIPE-ROLLWAY CORPORATION • SYRACUSE, NEW YORK**

## Fertilizer Placement Activities

*(Continued from page 166)*

to provide the farmers with distributing machinery permitted the application of 12,000,000 tons of fertilizer by an increased number of farmers.

Finally, as the Committee points out, the national policy on lime and fertilizer, recently issued by the U. S. Department of Agriculture and the War Food Administration, sets a goal for increasing consumption several times greater than present tonnages.

The personnel of the A.S.A.E. Committee on Fertilizer Application includes the following: G. A. Cumings (chairman), C. J. Allen, G. B. Nutt, G. W. Giles, J. A. Slipher, H. P. Smith, W. L. Zink, J. P. Fairbank, R. W. Wileman, C. H. White, C. H. Zirckel, R. W. Trullinger, F. A. Kummer, and H. V. Hansen.

## Personals of A.S.A.E. Members

*Waldo E. Bell,* who has been serving as a project engineer for the Soinl Conservation Service in Pennsylvania, recently accepted appointment as agricultural extension engineer for West Virginia. His new address is Oglebay Hall, West Virginia University, Morgantown, West Virginia.

*Henry E. Berns,* who has lately been serving as an instructor in the Naval Training School at Chicago, is now employed in the testing division of the engineering department at the Dodge-Chicago aviation engine plant.

*L. M. K. Boelter* was recently appointed dean of the college of enginering of the University of California at Los Angeles. Prior to the appointment he was professor of mechanical engineering in the engineering of the University at Berkeley.

*W. F. Heesch* until recently deputy director of the farm machinery and equipment branch of the War Production Board, is now affiliated with the Weaver Tractor Co., Sacramento, Calif., distributors for Caterpillar and John Deere products in several counties in central and east central California.

*Thomas E. Long,* formerly assistant agricultural engineer, North Dakota Agricultural Experiment Station, now holds the position of agricultural enginer with the agricultural extension bureau of the Republic Steel Corporation. He is engaged in research on farm buildings on the corporation's farm located at Paris, Kentucky, and in general agricultural extension work.

*R. I. Shawl,* chief of farm machinery, agricultural engineering department, University of Illinois, is author of a new bulletin entitled "Tractor Repair and Maintenance," just issued as Circular 589 by the University of Illinois. It is a revision of Circular No. 499.

*R. H. Wileman,* associate in agricultural engineering, Indiana Agricultural Experiment Station, is author of a progress report on mow curing of chopped and baled hay during the 1944 hay season, issued as Mimeo. No. 3 in November, 1944. He is also joint author with *R. C. Shipman,* assistant extension agricultural engineer, Purdue University, of Mimeo. No. 4, entitled "Planning a Mow Hay Curing System," issued February, 1945.

*Francis D. Yung,* research engineer in rural electrification, University of Nebraska, is author of agricultural engineering progress report No. 10, entitled "Nebraska Cream Receiving Cabinet," recently issued.

*Frank J. Zink,* who opened an office at 4300 Board of Trade Building, Chicago, about a year age as "consulting agricultural engineer and farm market analyst", announces the organization of "Frank J. Zink Associates," and the addition of W. Floyd Keepers to his staff. Mr. Keepers' responsibilities will include that of secretary of the newly formed Dairy Barn Equipment Association. Mr. Keepers was formerly director of the educational division of the Wheat Flour Institute. He was previously connected with the Caterpillar Tractor Company, and is a former managing editor of "Prairie Farmer."

Today, It's a Battle of MOVEMENT!

You can increase efficiency and simplify operations of almost any type of equipment by making it portable. Investigate the uses of EWC Wheels, Axles, Springs, Tongues, etc., to give equipment added value. Write today for Illustrated Bulletins, and for sound engineering help based on more than half a century of experience.

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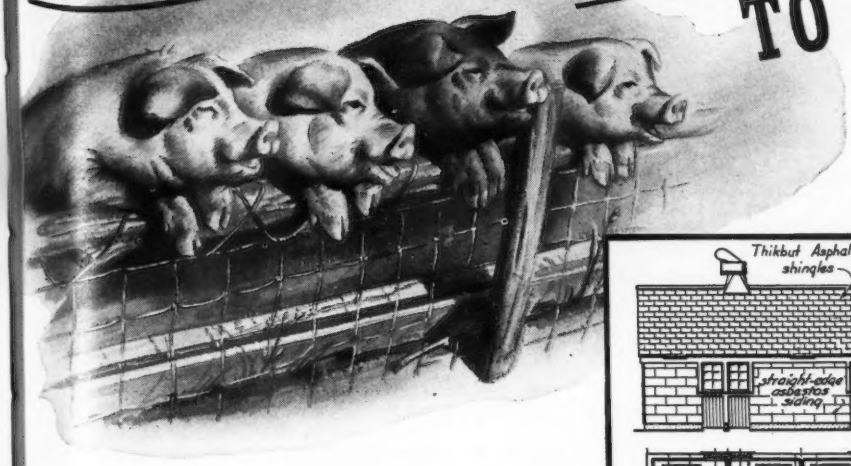
Electric Wheel Co., Dept. AE, Quincy, Ill.

# Four Little Pigs That DIDN'T GO TO MARKET!



FIGURES SHOW that only six out of ten pigs ever live to a marketable age . . . four out of ten *don't go to market.*

Correct management, of which proper housing is an important part, is essential to minimizing mortality losses. Tested methods have demonstrated that they can be held under 10%.

Centralized farrowing houses that are properly insulated and ventilated, farrowing quarters that are provided with pig guards and pig brooders, moveable units that are substantially built of the correct size and easily cleaned are but a few of the building facilities required for pig raising.

Flintkote's Agricultural Engineering Department is continually studying new livestock housing methods and developing new products and new applications to serve the farmers' needs. Write for details.

**FLINTKOTE FARM PRODUCTS**

Fire-resistant Asphalt Shingles—Durable, Fire-proof Asbestos Sidings—Insulated Brick Sidings—Easily applied Roll Roofings—Cold Process Built-up Roofs—Dampproofing and Waterproofing Materials—Decorative Insulating Board, Asphalt Sealed Sheathing, Lath and Rock Wool Insulation.

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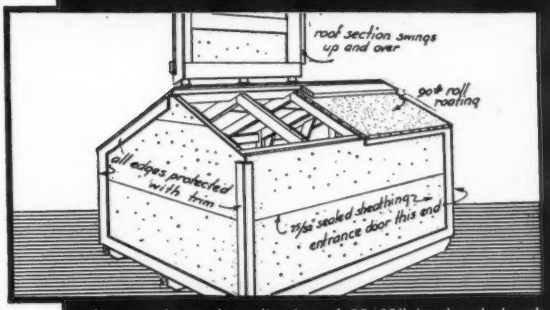
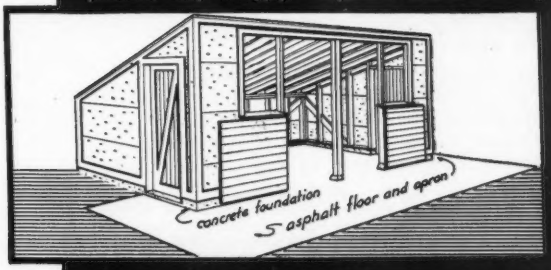
THE EXTRA YEARS OF SERVICE COST NO MORE

FLINTKOTE BUILDING MATERIALS

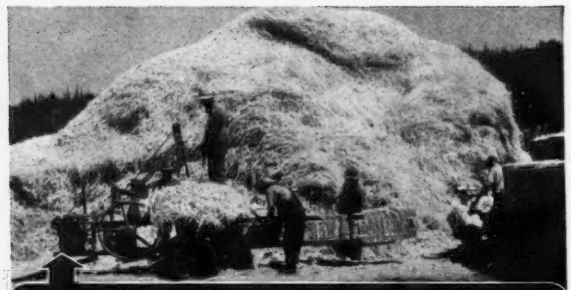
Centralized farrowing house. Designed to provide careful temperature regulation and minimum radiant heat loss per pen.


roof section swings up and over
90# roll roofing
all edges protected with trim
7/32" sealed sheathing
entrance door this end

An experimental application of 25/32" insulated sheathing as a covering for a moveable hog house. With proper surface treatment it promises interesting possibilities as a practical, easy to apply, inexpensive exterior covering.




When surfaced with Flintkote Static asphalt this sleeping shelter made of 25 32" insulated sheathing has given good service in Missouri for over a year.



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***Air-Cooled* ENGINES**
**on the Job . . . TRAILER BALING**

This J. I. Case Model "NL" Trailer Baler, which can be hitched to the bumper of a car and towed to the job, anywhere, illustrates a typical modern application of Wisconsin air-cooled engine power to farm service.

Complete freedom from cooling troubles and attention, light weight, compact design, and heavy-duty serviceability are considerations that make Wisconsin Engines especially desirable in farm operations.

Most H.P. per pound
**WISCONSIN MOTOR**
Corporation
MILWAUKEE 14, WISCONSIN, U. S. A.
*World's Largest Builders of Heavy-Duty Air-Cooled Engines*

## the BADGE of him who BELONGS

DESPITE the *presumption* it sets up, mere membership in the American Society of Agricultural Engineers is no *proof* of a man's high rank in technical talent. It does prove that he has met certain minimum requirements and has earned the esteem of colleagues who sponsored his application for membership.

But the Society emblem is *evidence* that native talent, be it great or small, is enriched by fraternity with the personalities whose minds fuse to form the pattern of progress in the methods and mechanics of agriculture. The wearer of the emblem waits not for the debut of an idea, but is present at its birth and helps to guide its growth.

Be you novice or veteran, your membership in the organized profession adds something to your efficiency, your vision, your influence as an individual engineer. The Society symbol on your lapel is token that you "belong". Wear it.

STYLES AND PRICES OF ASAE EMBLEMS

With blue ground for Fellows, Members, and Junior Members—furnished either in pin with safety clasp or lapel button—$2.00 each.

With red ground for Associates and Student-members — furnished only in pin with safety clasp — $1.00 each.

Send orders to ASAE, St. Joseph, Michigan.

## Hay Drying at Penn State

THE Pennsylvania Section of the American Society of Agricultural Engineers is sponsoring a two-day conference, to be held in the Agricultural Engineering Building, Pennsylvania State College, State College, on April 24 and 25, which will deal largely with the subject of mow curing of hay.

The program for the meeting will be informal, and persons attending, who have had experience in the mow curing of hay, will be called upon to give the benefit of their experiences. This includes not only agricultural engineers, but also representatives of companies manufacturing fans and other equipment essential to systems for mow curing of hay.

Another subject of growing interest to agricultural engineers, namely, farm ponds, will be the subject for discussion at the evening session of the conference on April 24.

A.S.A.E. members and others who plan to attend this conference should promptly notify the secretary of the Pennsylvania Section, E. W. Schroeder, agricultural engineering department, State College, Pa.

## Applicants for Membership

**The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.**

*Jai Ram Badola,* demonstrater, agricultural engineering, Government Agricultural College, Cawnpore, U. P. India. (Mail) V. Panchoor, P. O. Thangart, Dist., Garhwal.

*Merton N. Baird,* electrical engineer, General Electric Co., Ft. Wayne 8, Ind. (Mail) R.R. No. 6.

*William G. Beatty,* assistant drainage engineer, Tombigbee-Warrior Dist., Soil Conservation Service, Winfield, Ala.

*Wallace C. Bunnell,* chief architect in charge of barn planning dept., Louden Machinery Co., Fairfield, Iowa. (Mail) 203 E. Washington St.

*Peter L. Cashman,* estimator, Simonson Lumber Co. (Mail) 4554 Zenith Ave., So., Minneapolis, Minn.

*Walter S. Clevenger,* western manager, "Electricity on the Farm", 6 N. Michigan Ave., Chicago 2, Ill.

*G. A. F. de Lara,* designing engineer, Secretana de Agricultura y Fomento, Comision Nacional de Irrigacion, Mexico City, Mex.

*E. W. Garbisch,* Col., CE, USA. (Mail) U. S. Engineer Office, 120 Wall St., New York 5, N. Y.

*Roy C. Garrett,* acting assistant professor of agricultural engineering, Texas A & M College, College Station, Tex.

*J. P. Hollingsworth,* Lt.(jg), USNR. (Mail) MTB Sqd. 9, c/o Fleet Post Office, San Francisco, Calif.

*C. Rodney Johnson,* USA. (Mail) IORP, IRTC, Camp Blanding, Fla.

*Fred A. Karnik,* Senior engineering aide, Soil Conservation Service, USDA. (Mail) Powers Hotel, Fargo, N. D.

*J. F. O'Brien,* executive director, Pierce Foundation, and president, Pierce Laboratory, Inc. (Mail) Broadacres Farm, Cokesbury Road, Lebanon, N. J.

*L. M. Roche,* western representative, "Electricity on the Farm", Room 1220, 6 N. Michigan Ave., Chicago 2, Ill.

*Claud B. Williams,* assistant agricultural engineer, Soil Conservation Service, Konawa, Okla. (Mail) P.O. Box 321.

*Charles S. Young,* district representative, Louden Machinery Co. (Mail) 35 So. 10th St., Quakertown, Pa.

TRANSFER OF GRADE

*J. J. Brickley,* superintendent of agriculture, United Fruit Co. (Mail) Banes, Oriente, Cuba. (Associate to Member)

*A. K. Crawford,* agricultural engineer, engineering division, Weyerhaeuser Sales Co., 1st National Bank Building, St. Paul 1, Minn. (Junior Member to Member)

*Robert A. Kepner,* chief test engineer, heater division, Stewart-Warner Corp, Chicago, Ill. (Mail) 542 Surf St. (Junior Member to Member)

*Wesley M. Land, Jr.,* Capt., in charge of fire protection at Dekker Field, Ft. Benning Fire Dept. (Mail) Cottonton, Ala. (Junior Member to Member)

*Xzin McNeal,* assistant agricultural engineer, University of Arkansas, Fayetteville, Ark. (Junior Member to Member)

*Ben J. Pecena,* supply sergeant, Hq. & Hq. Det. (Co. A), USA. (Mail) R.R. No. 1, Wheelock, Tex. (Junior Member to Member)

*Cecil H. Robinson,* working manager, Robinson Hybrid Corn Co. (Mail) Radnor, Ohio. (Junior Member to Member)

*Charles C. Worstell,* design engineer, Moline Tractor Works of Deere and Co., Moline, Ill. (Mail) 1565 29th Ave. (Junior Member to Member)

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## FOR THE FARM OF TODAY AND TOMORROW

THE FOX takes the headaches out of the farmer's three toughest hand labor jobs: Haying, Forage Harvesting, and Silo Filling. Only with the FOX are these three jobs properly mechanized.

With the FOX Pick-Up Hay Cutter and Silage Harvester

—one man can pick up, chop and load, ready for the mow or stack, 2 tons of dry hay in 12 minutes.

—you can mow, chop and load, in one operation, over 200 tons of grass silage a day.

—cut corn of any height, chop it into silage and load it into wagons, ready for the silo, all in one operation.

*The FOX is built by the Pioneers of Modern Forage Harvesting. WRITE US—we will be glad to tell you about this marvelous machine.*

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Secretary

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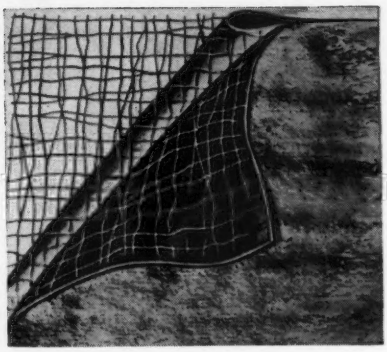
PORTABLE SILOS

HAY STACK COVERS

CORN CRIB COVERS

GRAIN STORAGE



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The two-way fibre reenforcement is embedded in water-proofing adhesive, between two thicknesses of kraft paper, making a durable "blanket" that has been used successfully to protect farm crops and equipment for nearly 25 years.

Folders on Treated SISALKRAFT for Portable Silos, Orange Label SISALKRAFT for Hay Stack Covers, Grain Storage Applications and other farm uses are yours on request.

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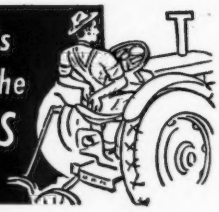

There is no longer any good reason why operators of farm tractors should suffer the discomfort and work-loss caused by hard, iron seats. There is nothing more painful than a Sacroiliac sprain, resulting from riding a tractor over rough ground . . . at a time when the rider is still "soft" from an inactive winter.

MILSCO CUSHION SEATS provide comfort where it's needed most. The form-fitting contour of these seats is heavily upholstered and covered with black leather or durable duck. The new, patented rolled edge design eliminates sharp corners which ordinarily hamper leg movement and cause fraying and unraveling of thread. The Cushion is *sealed-in* for greatest comfort, efficiency and long service.

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**No. 711**
Bucket Type Cushion Seat with or without Drain Slot.

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Bucket Type Cushion Seat with back rest.

Milsco MILWAUKEE *Cushion Seats* FOR FARM AND INDUSTRIAL EQUIPMENT


# EMPLOYMENT BULLETIN

**The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any Notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.**

## POSITIONS OPEN

ASSISTANT AGRICULTURAL ENGINEER wanted for research in farm structures, equipment, and utilities. Equal division between college of agriculture and agricultural experiment station, including cooperative projects with industry and public utilities. Salary depends upon qualifications and experience. Give full particulars, including military status with application. University of Idaho. PO-181

ASSISTANT AGRICULTURAL ENGINEER wanted for research in hydraulics, irrigation, soil and water conservation. Equal division between college of agriculture and the agricultural experiment station, including cooperative projects with Soil Conservation Service. Salary depends upon qualifications and experience. Give full particulars including military status with applications. University of Idaho. PO-180

DRAFTSMEN wanted. Farm tillage tool experience desired but not essential—otherwise one that can apply himself in this branch of design and development. Location near Chicago, Ill. A real opportunity for a man with vision. PO-179

ASSISTANT EXTENSION AGRICULTURAL ENGINEER wanted by Arkansas Agricultural Extension Service. The phases of work to be handled and the salary will depend primarily upon the training and experience of the applicant. Give brief explanation of training and experience in first letter. Write direct to L. A. Dhonau, State Agent, 524 Post Office Building, Little Rock, Ark.

AGRICULTURAL ENGINEERS, preferably men with some experience in farm equipment, are wanted by a nationally known manufacturer. Experience desired includes design, engineering applications, market research and merchandising. Excellent opportunity for men possessing either limited or broad experience. Salary open. Replies received on a confidential basis. Education, experience and special qualifications should be stated fairly complete in the first letter. PO-178

FARM IMPLEMENT ENGINEER AND DRAFTSMAN wanted to develop garden tractors, vegetable seeders, multiple-row cultivators, and hand and horse tools for home gardens and small growers. Position permanent. No postwar conversion. State education, experience, draft status, and salary expected. PO-177

AGRICULTURAL ENGINEER wanted. Practical man with sales experience to join large steel company entering farm building field. Dealer sales development program needs men between 28 and 42 with agricultural engineering background and proven sales record in farm equipment, building or similar fields. Excellent opportunity to get in on ground floor of promising postwar industry. Salary. In reply, give complete history of education and business experience as well as references and a small photo. All replies will be held confidential. PO-176

AGRICULTURAL ENGINEER wanted by the Allahabad Agricultural Institute, Allahabad, India, for teaching position. Minimum qualifications, degree in agricultural engineering and some farm experience. Postgraduate degree desirable. Duties would be primarily teaching, but some opportunity to participate in research and extension. Candidate must be active Christian interested in mission work. Discharged veteran with slight handicap eligible, if in good health otherwise. Applicants may correspond with Mason Vaugh, 1462 Beall Ave., Wooster, Ohio, or Board of Foreign Missions, Presbyterian Church in U.S.A., 156 Fifth Ave., New York 10, N. Y.

DISTRICT MANAGER wanted for western New York. Experience in the sale of dairy farm equipment helpful, but not essential. Must have automobile. Postwar future. Salary, expense allowance, commission, and bonus. Thorough field training, during which salary and expenses are paid. Write in detail, stating age, education, experience, and at least three character references. PO-175

RESEARCH ENGINEER wanted for work in farm structures and rural electrification in a land-grant college in a north central state. A young man is preferred. Salary will depend upon qualifications. Write giving full details of education, experience, draft status, and other particulars. PO-174 *(Continued on page 176)*

# *This* DOUBLE SCRUBBING AIR CLEANER *WILL NOT CLOG*

## IT SCRUBS ITSELF AS IT SCRUBS THE AIR . . . *Completely Self-washing*

There is no filter pack in the Donaldson Oil-Washed Air Cleaner to be rinsed or replaced. The heavy gauge wire screen element is *permanent*. Each of its precisely formed components is forced into place under pressure and locked into one rigid unit. It cannot flex under vibration to cause breakdown. The element functions as an oil condenser only. Servicing is confined to cleaning the oil cup and replacing with fresh oil.

The Donaldson cleaner combines large dirt capacity with the compactness necessary for mobile units. This dependable cleaner with its streamlined collector pre-cleaner is being fitted to more and more power units . . . both diesel and gasoline powered . . . serving purposes of war and peace.

**WHAT SIZE AND TYPE OF AIR CLEANER** shall I use for greatest protection? Let the Donaldson engineering staff answer this question for you. They can furnish a cleaner to fit any requirements. Write—

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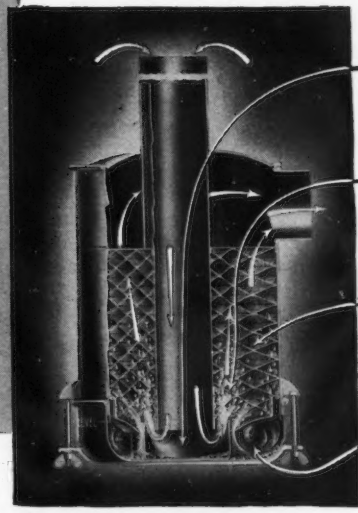
CHICAGO OFFICE: 600 SOUTH MICHIGAN AVENUE, CHICAGO, ILL.



Submerged air inlet insures impingement of dust particles and constant, high cleaning efficiency.

Double scrubbing action. Turbulent oil-scrubbing cleans the element as it cleans the air.

Lead coated screen element functions as condenser . . . not filter. No restriction build-up because of dirt plugged filter pack.

Quiet-zone dirt separation. Impinged dust is carried down out of element into quiet zone of oil cup where it settles out. Cleanest oil is used in scrubbing.

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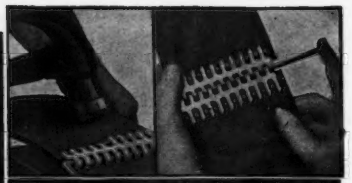
**DONALDSON CO. INC.** AIR CLEANERS AND CRANKCASE VENTILATING SYSTEMS

BELT LACING and FASTENERS for transmission and conveyor belts



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STEEL BELT LACING

World famed in general service for strength and long life. A flexible steel-hinged joint, smooth on both sides. 12 sizes. Made in steel, "Monel Metal" and non-magnetic alloys. Long lengths supplied if needed. Bulletin A-60 gives complete details.

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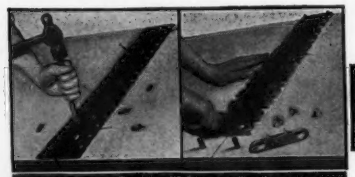
BELT FASTENERS AND RIP PLATES

For conveyor and elevator belts of all thicknesses, makes a tight butt joint of great strength and durability. Compresses belt ends between toothed cupped plates. Templates and FLEXCO Clips speed application. 6 sizes. Made in steel, "Monel Metal", non-magnetic and abrasion resisting alloys.

By using Flexco HD Rip Plates, damaged conveyor belting can be returned to satisfactory service. The extra length gives a long grip on edges of rip or patch. Flexco Tools and Rip Plate Tool are used. For complete information ask for Bulletin F-100.

*Sold by supply houses everywhere*



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RATES: Announcements under the heading "Professional Directory" in AGRICULTURAL ENGINEERING will be inserted at the flat rate of $1.00 per line per issue; 50 cents per line to A.S.A.E. members. Minimum charge, four-line basis. Uniform style setup. Copy must be received by first of month of publication.

## EMPLOYMENT BULLETIN

*(Continued from page 174)*

FACTORY MANAGER with agricultural engineering background wanted to take charge of a small factory producing barn equipment and hay tools. A permanent position for a man with executive ability and one who is interested in research and development. In first letter give full details as to education, experience, family status, age, etc. PO-173

SALES ENGINEER wanted for permanent position with small company producing well-accepted building material products. Substantial base salary, better than average proposition for man with liking for sales work and knowledge of building construction. Give full information on past experience and earnings expected. PO-166

AGRICULTURAL ENGINEER wanted by a well-known national organization to engage in sales promotion work on farm buildings, preferably someone in his early thirties with good engineering training and farm background and with plenty of initiative and ingenuity. Special training in farm buildings would be helpful to person selected. Discharged service men will receive special consideration. Write giving full details as to education, experience, etc. PO-164

### POSITIONS WANTED

AGRICULTURAL ENGINEER, graduate of Cornell University, with 5 years' experience in college teaching, research and extension; 1 year in research and advertising; 12 years in retail building material sales and service; 3 years scheduling and expediting for WFA, desires position with firm having production, sales or service problems in New York, Pennsylvania, Maryland, or Virginia. PW-370

AGRICULTURAL ENGINEER with B. S. degree in agricultural engineering from Pennsylvania State College desires position on a farm. Experience in repairing farm machinery and capable of making improvements in machines. Two years' experience in teaching agricultural engineering at a university, and two years in managing a cooperative business. Age 27. Married, with two children. PW-369

AGRICULTURAL ENGINEER, with B.S. in agricultural engineering from midwestern university, desires position in industry or in any branch of agricultural engineering, preferably in soil and water or farm structures fields. Experience in research and development in chemical soil stabilization. Recently honorably discharged from the armed forces. Married and in good physical condition. Age 23. References and professional record available upon request. PW-367

RESEARCH ENGINEER (electrical-agricultural) is available. Has a bachelor of science degree in electrical engineering (1933), master's degree in agriculture (1934), degree of agricultural engineer (1939) and is now working for a Ph. D.; also has engineering license. Temporarily employed as an extension electrical-agricultural engineer on wartime food production problems. Ten and one-half years' experience since earning master's degree in agriculture; four and one-half years' in government civil service, and five and one-half years' in other than government service. Born and reared on a farm. Thirty-four years of age, married, two children. Available at a salary range of from $4000 to $8000 per year. PW-365